Planning and Environmental Consultants

Environmental Impact Assessment Report (EIAR)

Seskin Wind Farm, Co. Carlow

Chapter 8 – Land Soils and Geology

Table of Contents

TABLE OF TABLES

TABLE OF FIGURES

8. LAND SOILS AND GEOLOGY

8.1 Introduction

8.1.1 Background and Objectives

Hydro-Environmental Services (HES) was engaged by MKO Ireland (MKO) to carry out an assessment of the potential likely and significant effects of the Proposed Project on the Land, Soils and Geology aspects of the receiving environment.

The Proposed Project is described in full in Chapter 4 of this EIAR.

This chapter provides a baseline assessment of the environmental setting of the Proposed Project, as described in Chapter 4, in terms of land, soils and geology and discusses the potential likely significant effects that the construction, operation and decommissioning of the Proposed Project will have. Where required, appropriate mitigation measures to avoid any identified significant effects to land, soils and geology (i.e. natural resources) are recommended and the residual effects of the Proposed Project post-mitigation are assessed.

As detailed in Section 1.1.1 in Chapter 1, for the purposes of this EIAR, the various project components are described and assessed using the following references: 'Proposed Project', 'Proposed Wind Farm', 'Proposed Grid Connection Route' and the 'site'.

8.1.2 Statement of Authority

Hydro-Environmental Services (HES) are a specialist geological, hydrological, hydrogeological and environmental practice which delivers a range of water and environmental management consultancy services to the private and public sectors across Ireland and Northern Ireland. HES was established in 2005, and their office is located in Dungarvan, County Waterford.

HES's core areas of expertise and experience includes soils, subsoils and geology. HES routinely complete impact assessments for land, soils and geology, hydrology and hydrogeology for a large variety of project types including wind farms and renewable energy projects.

This chapter of the EIAR was prepared by Michael Gill and Conor McGettigan.

Michael Gill P.Geo (BA, BAI, Dip Geol., MSc, MIEI) is a Civil/Environmental Engineer and Hydrogeologist with over 22 years' environmental consultancy experience in Ireland. Michael has completed numerous hydrological and hydrogeological impact assessments of wind farms and renewable projects in Ireland. In addition, he has substantial experience in geological characterisation, peatland morphology, and surface water drainage design and SUDs design and surface water/groundwater interactions. Michael has worked on the EIS/EIAR for Oweninny WF, Cloncreen WF, Derrinlough WF and over 100 other wind farm related projects across the country.

Conor McGettigan (BSc, MSc) is an Environmental Scientist with over 3 years' experience in the environmental sector in Ireland. Conor holds an M.Sc. in Applied Environmental Science (2020) and a B.Sc. in Geology (2016) from University College Dublin. Conor routinely prepares the land, soils and geology chapters of environmental impact assessment reports for wind farm development on peatlands.

8.1.3 Relevant Legislation

The EIAR is prepared in accordance with the requirements of European Union Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (the 'EIA Directive') as amended by Directive 2014/52/EU. The requirements of the following legislation are complied with:

- Planning and Development Acts, 2000-2023;
- Planning and Development Regulations, 2001 (as amended);
- Directives 2011/92/EU and 2014/52/EU on the assessment of the effects of certain public and private projects on the environment; and,
- The Heritage Act 1995, as amended.

8.1.4 Relevant Guidance

The Land, Soils and Geology chapter of this EIAR was prepared in accordance with, where relevant, the guidance contained in the following documents:

- Environmental Protection Agency (2022): Guidelines on the Information to be contained in Environmental Impact Assessment Reports;
- Institute of Geologists Ireland (2013): Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements;
- National Roads Authority (2008): Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;
- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (DoHPLG, 2018); and,
- Guidance on the preparation of the EIA Report (Directive 2011/92/EU as amended by 2014/52/EU), (European Commission 2017).

8.2 Assessment Methodology

8.2.1 Desk Study

A desk study of the Proposed Project site was completed in the Summer of 2022 to collect all relevant geological data for the Proposed Project site and the surrounding area. The desk study was completed to supplement site walkover surveys and site investigations. The desk study information has been checked and updated, where necessary, in January and February 2024.

The desk study included consultation with the following data sources:

- Environmental Protection Agency database (www.epa.ie);
- Geological Survey of Ireland - Groundwater and Geology Databases (www.gsi.ie);
- Geological Survey of Ireland – Geological Heritage site mapping (www.gsi.ie);
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 19 (Geology of Carlow - Wexford). Geological Survey of Ireland (GSI, 1997);
- Geological Survey of Ireland – 1:25,000 Field Mapping Sheets;
- General Soil Map of Ireland 2nd edition (www.epa.ie); and,
- Aerial Photography, 1:5000 and 6 inch base mapping.

8.2.2 Baseline Monitoring and Site Investigations

Site walkover surveys, including geological mapping and investigation of the Proposed Project site were undertaken by Conor McGettigan of HES (refer to Section 8.2.1 above for qualifications and experience) on 24th August 2022, 14th July 2023 and 14th December 2023.

Geotechnical ground investigations and a peat stability assessment were undertaken by Causeway Geotechnical Limited and AFRY. The combined geological and hydrogeological dataset collated by HES, MKO, AFRY and Causeway Geotechnical has been used in the preparation of this EIAR Chapter.

The objectives of the intrusive site investigations included mapping the distribution and depth of peat at the Proposed Wind Farm site along with assessing the mineral subsoil / bedrock conditions beneath the peat at key development locations (refer to Chapter 4 for a description of the components of the Proposed Project). This data was used to inform the final layout design.

In summary, site investigations to address the Land, Soils and Geology chapter of the EIAR included the following:

- A total of 314 no. peat probes were carried out by MKO in June and August 2023 to determine the depth and geomorphology of the peat at the Proposed Wind Farm site;
- Gouge core sample points were undertaken by HES (August 2022, July and December 2023) at proposed infrastructure locations (turbines, met mast, substation compound) to investigate peat and underlying mineral soil lithology;
- HES also completed a visual assessment of exposed soils, subsoil and bedrock and topographic changes along the Proposed Grid Connection Route;
- Causeway Geotechnical completed 8 no. trial pits, 6 no. dynamic probes and 28 no. hand vane tests to investigate underlying mineral soil lithology and the subsoil/bedrock interface. These site investigation works were completed in November 2023;
- AFRY completed site walkover surveys at the Proposed Wind Farm Site between July 2023 and January 2024;
- Logging of subsoil exposures across the site where mineral soils and peat profiles are exposed; and,
- Mineral subsoils and peat were logged according to BS: 5930 and Von Post Scale respectively.

The Geotechnical and Peat Stability Assessment Report and Peat and Spoil Management Plan prepared by AFRY Ireland Ltd (2024) are included as Appendix 8-1 and Appendix 4-2 of this EIAR respectively.

8.2.3 Scope and Consultation

The scope for this EIAR has been informed by consultation with statutory consultees, bodies with environmental responsibility and other interested parties. This consultation process is outlined in Section 2.6 of this EIAR.

Carlow County Council and the Geological Survey of Ireland (GSI) were the only consultees to respond with respect to the Land, Soils and Geological environment. Their responses are summarised in Table 8-1. The GSI response was informative in nature with regard to sources of online data for baseline assessment purposes.

Table 8-1: Summary of Scoping Responses

Consultee	Description	Addressed in Section
Carlow Co. Co.	A Geological Report should be done (including slope stability assessment).	Refer to Section 8.3.8 and Appendix 8-1 for Peat Stability Risk Assessment.
GSI	The GSI encouraged the use of their various geological datasets when conducting the EIAR.	The publicly available GSI databases where used during the preparation of this chapter as detailed in Section 8.2.1.

8.2.4 Impact Assessment Methodology

Using information from the desk study and data from the site investigations, an assessment of the importance of the land, soil and geological environment within the Proposed Project site is assessed using the criteria set out in Table 8-2 (NRA, 2008).

Table 8-2 Estimation of Importance of Soil and Geology Criteria (NRA, 2008).

Importance	Criteria	Typical Example
Very High	Attribute has a high quality, significance or value on a regional or national scale. Degree or extent of soil contamination is significant on a national or regional scale. Volume of peat and/or soft organic soil underlying the site is significant on a national or regional scale.	Geological feature rare on a regional or national scale (National Heritage Area (NHA)). Large existing quarry or pit. Proven economically extractable mineral resource
High	Attribute has a high quality, significance or value on a local scale. Degree or extent of soil contamination is significant on a local scale. Volume of peat and/or soft organic soil underlying site is significant on a local scale.	Contaminated soil on site with previous heavy industrial usage. Large recent landfill site for mixed wastes. Geological feature of high value on a local scale (County Geological Site). Well drained and/or highly fertile soils. Moderately sized existing quarry or pit Marginally economic extractable mineral resource.
Medium	Attribute has a medium quality, significance or value on a local scale. Degree or extent of soil contamination is moderate on a local scale. Volume of peat and/or soft organic soil underlying site is moderate on a local scale.	Contaminated soil on site with previous light industrial usage. Small recent landfill site for mixed Wastes. Moderately drained and/or moderate fertility soils. Small existing quarry or pit. Sub-economic extractable mineral Resource.
Low	Attribute has a low quality, significance or value on a local	Large historical and/or recent site for construction and demolition wastes.

Importance	Criteria	Typical Example
	scale. Degree or extent of soil contamination is minor on a local scale. Volume of peat and/or soft organic soil underlying site is small on a local scale.	Small historical and/or recent landfill site for construction and demolition wastes. Poorly drained and/or low fertility soils. Uneconomically extractable mineral Resource.

The assessment of effects follows the description of the baseline environment and is Stage 6 of 7 of the information which must be included in an EIAR (EPA, 2022). The guideline criteria for the assessment of effects states that the purpose of an EIAR is to identify, describe and present an assessment of the likely significant effects. The likely effects are described with respect to their quality (positive, neutral or negative), significance (imperceptible to profound), extent (i.e. size of area or number of sites effected), context (is the effect unique of being increasingly experienced), probability (likely or unlikely), duration (momentary to permanent), frequency and reversibility. The descriptors used in this environmental impact assessment are those set out in the EPA (2022) glossary of effects as shown in Chapter 1 of this EIAR.

In order to provide an understanding of this descriptive system in terms of the geological/hydrological environment, elements of this system of description of effects are related to examples of potential likely significant effects on the geology and morphology of the existing environment, as listed in Table 8-3.

Table 8-3: Impact descriptors related to the receiving environment.

Impact Characteristics		Potential Hydrological Impacts
Quality	Significance	
Negative only	Profound	Widespread permanent impact on: › The extent or morphology of a candidate Special Area of Conservation (cSAC). › Regionally important aquifers. › Extents of floodplains. Mitigation measures are unlikely to remove such impacts.
Positive or Negative	Significant	Local or widespread time-dependent impacts on: › The extent or morphology of a cSAC / ecologically important area. › A regionally important hydrogeological feature (or widespread effects to minor hydrogeological features). › Extent of floodplains. Widespread permanent impacts on the extent or morphology of an National Heritage Area (NHA)/ecologically important area. Mitigation measures (to design) will reduce but not completely remove the impact – residual impacts will occur.
Positive or Negative	Moderate	Local time-dependent impacts on:

Impact Characteristics		Potential Hydrological Impacts
Quality	Significance	
		› The extent or morphology of a cSAC / NHA / ecologically important area. › A minor hydrogeological feature. › Extent of floodplains. Mitigation measures can mitigate the impact OR residual impacts occur, but these are consistent with existing or emerging trends
Positive, Negative or Neutral	Slight	Local perceptible time-dependent impacts not requiring mitigation.
Neutral	Imperceptible	No impacts, or impacts which are beneath levels of perception, within normal bounds of variation, or within the bounds of measurement or forecasting error.

8.2.5 Study Area

The study area for the land, soils and geological environment is limited to within the EIAR Site Boundary. There is no potential for the Proposed Project to effect the land, soils and geological environment outside of the Proposed Project site.

8.2.6 Limitations and Difficulties Encountered

No limitations or difficulties were encountered during the preparation of the Land, Soils and Geology Chapter of the EIAR.

8.3 Existing Environment

8.3.1 Proposed Project Site Description and Topography

8.3.1.1 Proposed Wind Farm

The Proposed Wind Farm site is located ~3.1km northwest of the village of Old Leighlin, ~5km northwest of the Leighlinbridge town, in west Co. Carlow and ~9.9km southeast of Castlecomer, Co. Kilkenny. The Carlow – Kilkenny County border, locally marked by the Coolcullen River, is situated ~1km west of the Proposed Wind Farm site. The Proposed Wind Farm site is situated in the townlands of Agharue and Coolnakisha in the north, Seskinrea towards the centre and the townland of Ridge in the south. The site has a total area of 370 hectares.

The Proposed Wind Farm site is located in an upland settling and is dominated by coniferous forestry plantations with some heath and agricultural lands. The Proposed Wind Farm site contains an existing network of local roads and forestry roads. Access can be gained from a local road (L30372) which dissects the Proposed Wind Farm site, joining a small village to the west, known as The Butts, to Tullouoreen Cross Roads in the east. Another local road (L7123) runs along the eastern boundary of the Proposed Wind Farm site.

The Proposed Wind Farm site is located on the Castlecomer Plateau, an upland area in north Co. Kilkenny which also extends into Co. Laois and Co. Carlow at its northern edge. The local topography within the Proposed Wind Farm site is hilly, with land generally sloping in a westerly direction towards the Coolcullen River. Elevations within the Proposed Wind Farm site range from ~230mOD (metres above Ordnance Datum) in the west to ~271m in the northeast.

Turbine Delivery Route

The Turbine Delivery Route (TDR) extends from Waterford Port (Bellview) to the Proposed Wind Farm site as detailed in Chapter 4, Section 4.5.

Some minor accommodation works are located at several locations along the TDR (detailed in Chapter 4). More significant works are located at 2 no. locations:

- The junction between the N78 and the L1834 will require the construction of a new temporary link road to facilitate the delivery of the turbine components; and,
- Permanent carriageway strengthening works are required at the Black Bridge, where the L1835/L3037 crosses the River Dinin.

8.3.1.2 Proposed Grid Connection Route

The Proposed Grid Connection Route from the proposed onsite 38kV substation to the existing Kilkenny 110kV substation is 20.1km. The Proposed Grid Connection Route begins along the L30372, travelling to the west. The Proposed Grid Connection Route then travels to the southwest along the L30371 as far as Ballysallagh, Co. Kilkenny. The Proposed Grid Connection Route continues southwards along the L2627 before joining the R712. The Proposed Grid Connection Route continues for ~1.8km along this regional road before terminating at Kilkenny 110kV substation.

Much of the Proposed Grid Connection Route is located within the Castlecomer Plateau and has elevations in excess of 100mOD. The southern section has lower elevations of 70 - 80mOD.

8.3.2 Land and Land Use

8.3.2.1 Proposed Wind Farm

Corine land cover maps (2018) (www.epa.ie) show that the Proposed Wind Farm site comprises of coniferous forestry surrounded by agricultural pastures. No significant land use changes have been recorded by historic Corine mapping (1990 - 2018).

Land cover at the Proposed Wind Farm site has been verified during site walkover surveys completed by HES and from the inspection of recent aerial imagery. The Proposed Wind Farm site was noted to comprise of largely coniferous forestry, with some felled areas containing tree roots and stumps. The coniferous plantations are surrounded by agricultural pastures which are separated by hedgerows.

The land cover at the location of the key Proposed Wind Farm infrastructure is detailed in Table 8-4.

Table 8-4: Existing Land Cover at Proposed Wind Farm Infrastructure Locations

Proposed Wind Farm Key Infrastructure Element	Land Cover
T01, T06, onsite 38kV substation and battery storage compound, met mast and 2 no. temporary construction compounds	Agricultural pastures
T04	Coniferous forestry plantations
T02, T05 and T07	Coniferous forestry plantations and recently felled areas
T03	Agricultural pastures and recently felled areas

Turbine Delivery Route

The accommodation works at the junction between the N78 and the L1834 are located in agricultural pastures. The works at the Black Bridge are located at an existing watercourse crossing along the L1835/L3037.

8.3.2.2 Proposed Grid Connection Route

The Proposed Grid Connection Route is located in the carriageway of the existing public road network.

According to Corine land cover mapping (2018) (www.epa.ie), the majority of the lands surrounding the Proposed Grid Connection Route are comprised of agricultural pastures and heterogenous agricultural areas. Smaller sections of the Proposed Grid Connection Route are bounded by forestry plantations. Land use along the Proposed Grid Connection Route was verified during walkover surveys.

8.3.3 Peat/Soils and Subsoils

8.3.3.1 Proposed Wind Farm

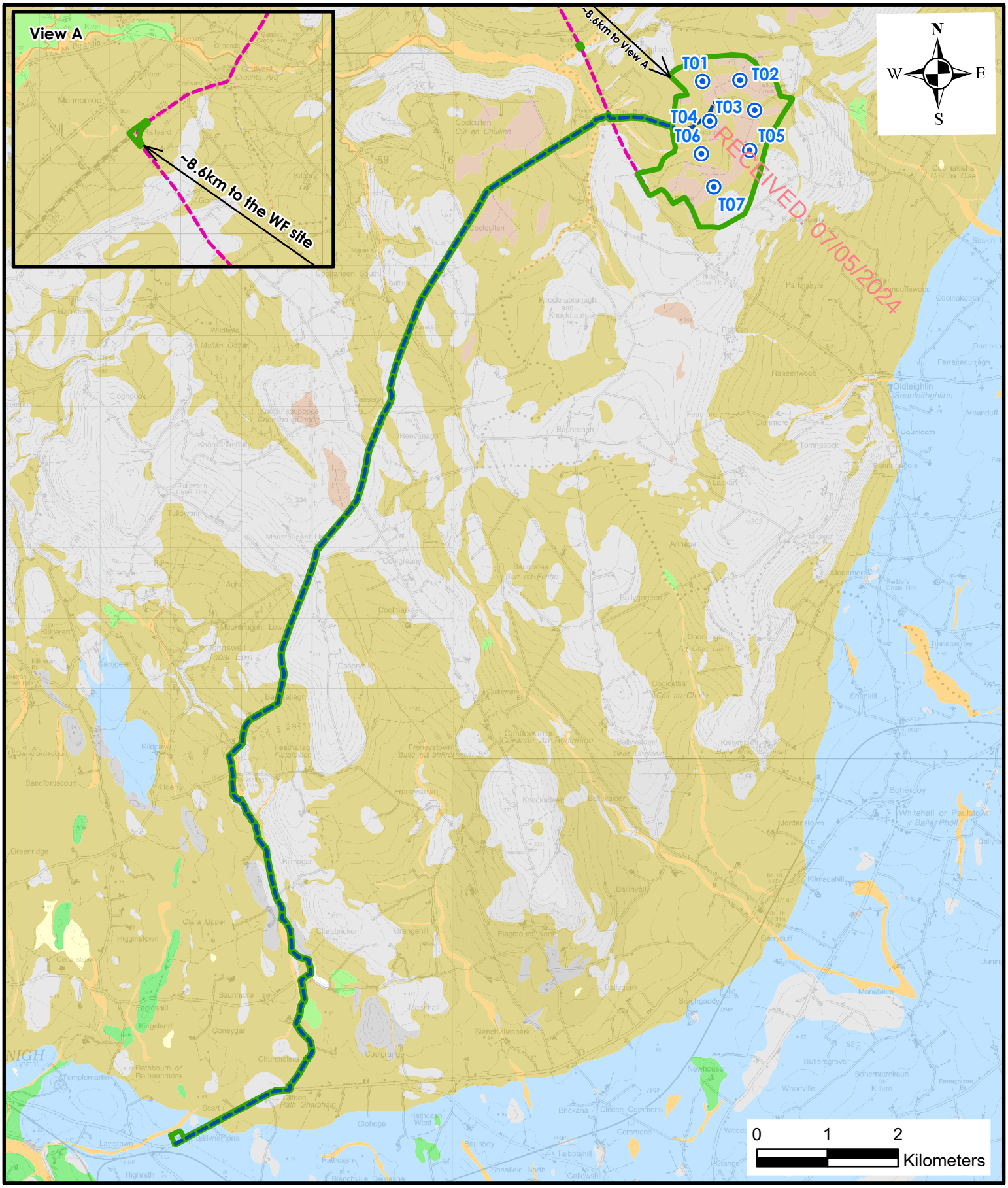
The published Teagasc soils map (www.gsi.ie) shows that the Proposed Wind Farm site is predominantly overlain by acid peaty and non-peaty poorly drained mineral soils. Blanket peat is mapped to overlie some areas of the Proposed Wind Farm site and many of the proposed infrastructure locations. Acid shallow poorly drained mineral soils are also mapped in the southeast of the Proposed Wind Farm site.

Other mapped soils in the surrounding lands include local pockets of acidic deep well drained mineral soils. Mineral alluvium is also mapped along the Coolcullen River and its tributaries.

The GSI subsoils map (www.gsi.ie) shows that the Proposed Wind Farm site is largely underlain by till derived from Namurian sandstones and shales. Areas of blanket peat are also mapped within the Proposed Wind Farm site and underlie several proposed infrastructure locations. The GSI also map the occurrence of bedrock outcrop or subcrop in the southeast of the Proposed Wind Farm site. A small area of alluvium is mapped to encroach upon the west of the Proposed Wind Farm site, mapped along a tributary of the Coolcullen River.

The mapped subsoils in the surrounding lands are largely similar to those mapped within the Proposed Wind Farm site, dominated by till derived from Namurian sandstones and shales and areas of bedrock outcrop, with smaller pockets of blanket peat and alluvium mapped along local watercourses.

A subsoil geology map for the Proposed Project site is shown as Figure 8-1 below.



Legend

- EIAR Site Boundary
- Proposed Turbine Layout
- Proposed Grid Connection Route
- Proposed Turbine Delivery Route

Subsoils

- A, Alluvium
- BktPt, Blanket Peat
- GLs, Gravels derived from Limestones
- GNSSs, Gravels derived from Namurian sandstones and shales
- KaRck, Kartsified bedrock outcrop or subcrop
- L, Lacustrine sediments
- Rck, Bedrock outcrop or subcrop
- TLs, Till derived from limestones
- TNSSs, Till derived from Namurian sandstones and shales

Client: EDF Renewables Ireland Ltd.

Job: Seskin WF, Co. Carlow

Title: Local Subsoils Map

Figure No: 8-1

Drawing No: P1599-0-0524-A4-801-00A

Scale: 1:70,000

Drawn By: GA

Sheet Size: A4

Project No: P1599-0

Date: 01/05/2024

Checked By: MG

HYDRO ENVIRONMENTAL SERVICES
22 Lower Main St
Dungarvan
Co.Waterford
Ireland
tel: +353 (0)58 44122
fax: +353 (0)58 44244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie

The soils and subsoils present at the Proposed Wind Farm site have been confirmed by site investigations comprising of peat probes, gouge cores and trial pits.

A total of 314 no. peat probes were completed at the Proposed Wind Farm site by MKO in June and August 2023. These peat probe investigations revealed the presence of generally shallow peat with localised areas of deep peat. The peat depths recorded during these site investigations ranged from 0 to 2.7m, with an average of 0.23m. No peat was recorded at ~40% of the peat probe locations (116 no. locations). 96% of peat probes recorded peat depths <1m (301 no. locations). Peat depth was found to exceed 2m in only 4 no. locations. The deepest peat (2.7m) was recorded ~60m north of T5. A peat depth distribution plot is shown as Figure 8-2 below.

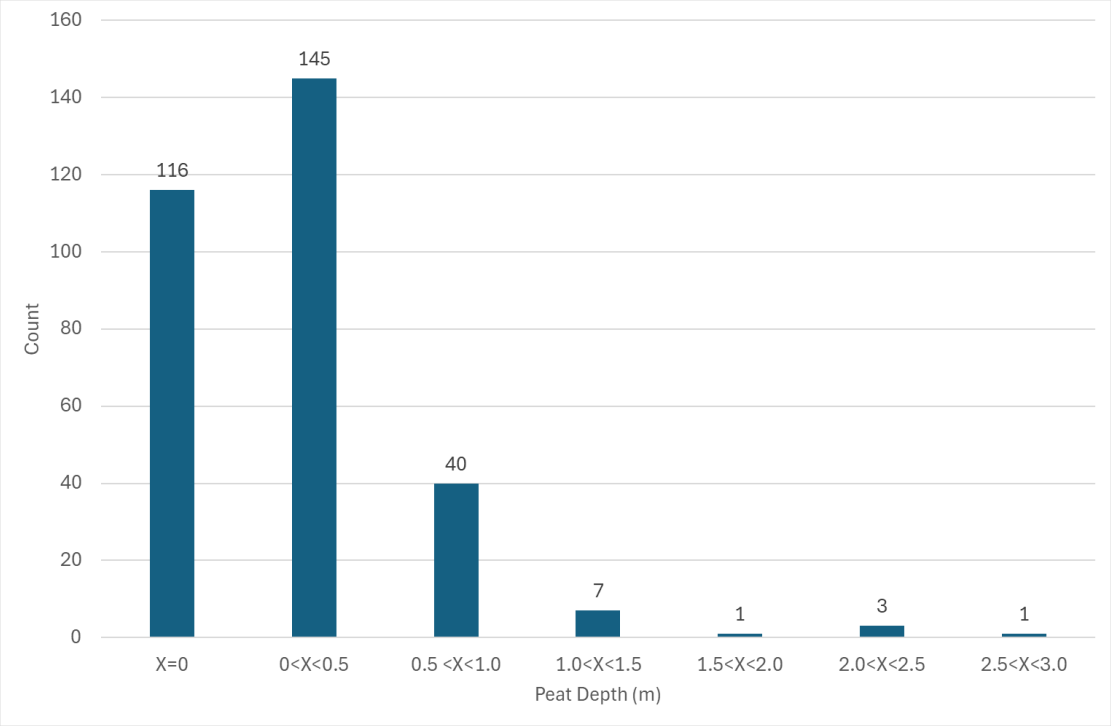


Figure 8-2: Peat Depth Distribution Plot

The peat probe dataset was supplemented by gouge cores completed by HES at the Proposed Project infrastructure locations. The data from these investigations are detailed in Table 8-5 below. Based on these site investigations completed by HES, the peat at the Proposed Project infrastructure locations was noted to be shallow, ranging from 0 to 0.45m. The subsoils beneath the peat were noted to comprise of grey, firm, dense gravelly SILT/CLAY.

Table 8-5: HES Site Investigation Data

Proposed Project Infrastructure Location	HES Gouge Core (peat depth range)	Soil/Subsoil Lithology
T01	0.1 – 0.15	Firm, dense grey CLAY
T02	0.07 – 0.12	Firm, dense grey CLAY
T03	No peat	Loose brown SILT/CLAT TOPSOIL
T04	0.08 – 0.14	Firm, dense grey CLAY
T05	0.38 – 0.45	Firm, pale grey SILT/CLAY
T06	0.2 – 0.31	Hard base – no returns
T07	0.42 – 0.45	Firm, dense grey CLAY

Proposed Project Infrastructure Location	HES Gouge Core (peat depth range)	Soil/Subsoil Lithology
Substation and Battery Storage Compound	0 9 (0.1m peaty TOPSOIL)	Hard base – no returns
Temporary Construction Compound (North)	0.1	Hard base – no returns
Temporary Construction Compound (South)	0.2	Hard base – no returns
Met Mast	No peat	Loose brown SILT/CLAT TOPSOIL
Peat Repository Area (North)	0.15	Firm, dense grey CLAY
Peat Repository Area (Centre)	0.42	Firm, pale grey SILT/CLAY
Peat Repository Area (South)	0.3	Firm, pale grey SILT/CLAY

Causeway Geotechnical completed site investigations at the Proposed Wind Farm site between 1st and 28th November 2023. These site investigations comprised the completion of 8 no. trial pits, 6 no. dynamic probes and 28 no. hand vane tests. The results are included in full in Appendix D of the Geotechnical and Peat Stability Assessment Report (Appendix 8-1).

The trial pits were completed at the 7 no. proposed turbine locations and at the location of the proposed 38kV onsite substation and battery storage compound. The trial pits extended to a maximum depth of 2.7mbgl. The location of these trial pits are shown on Figure 8-3 and detailed logs are included in Appendix D of the Geotechnical and Peat Stability Assessment Report (Appendix 8-1). Based on the site-specific data obtained from the trial pit investigations, the ground conditions at the Proposed Wind Farm site can be summarised as follows:

- TOPSOIL was encountered at all trial pit investigations. The thickness of the topsoil was found to range from 0.3 to 0.5m;
- The topsoil was underlain by glacial till. The till is noted to be comprised of sandy, gravelly or silty CLAY, frequently with low to medium cobble content, typically firm or stiff. Meanwhile, grey, very silty, fine to coarse SAND was recorded at T05 underlying the topsoil and extended to a depth >2.3mbgl;
- Angular sandy silty GRAVEL deposits were encountered at T02 and T03. This was noted on the geological logs as possibly being weathered bedrock; and,
- Competent bedrock was not encountered in any of the trial pit excavations.

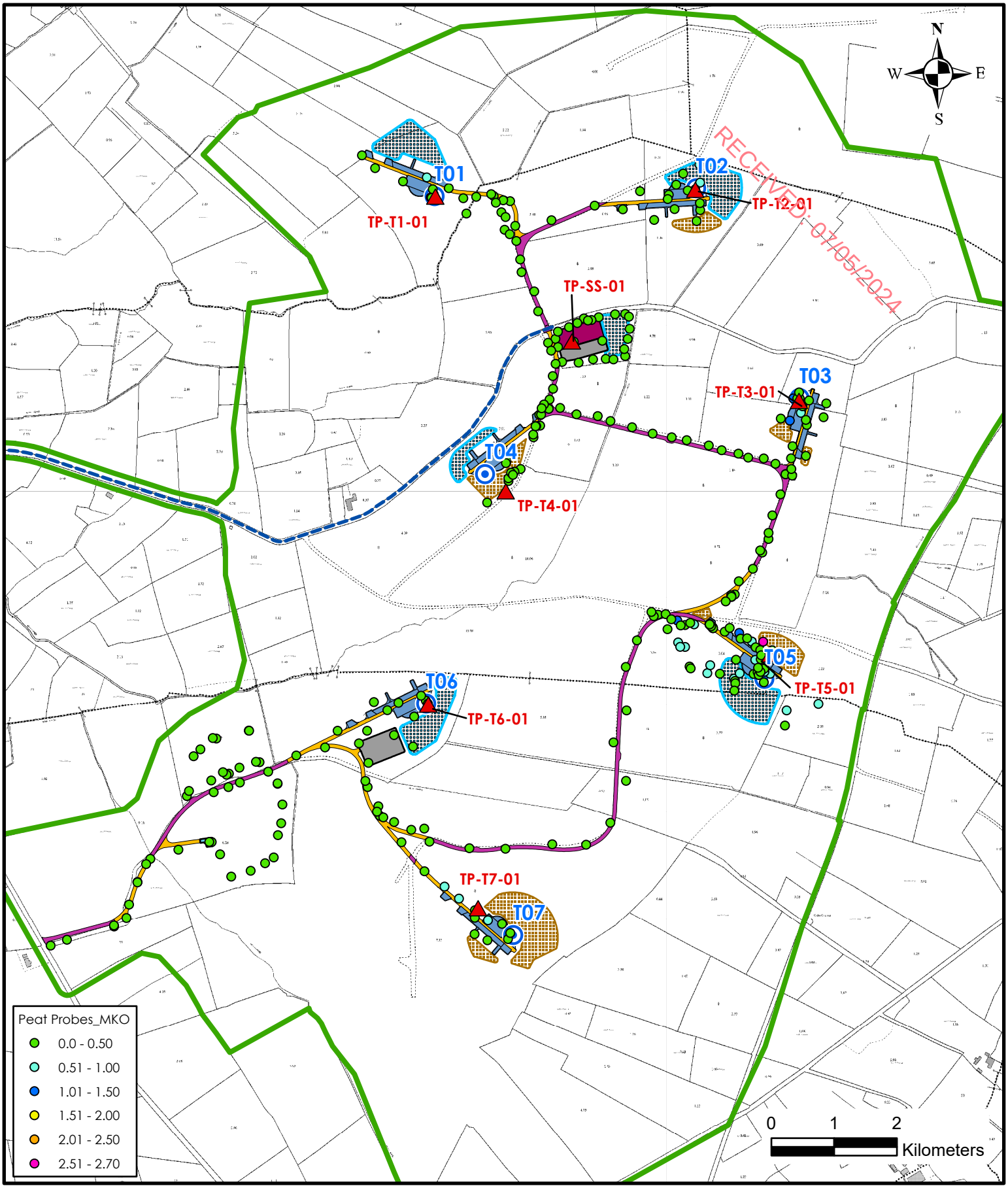
Particle Size Distribution (PSD) analysis was completed at all of the trial pit locations. All of the samples were described in the logs as being slightly sandy, slightly gravelly CLAY. The results of the PSD analysis are shown on Figure 8-4 below. Based on the PSD analysis the SILT is the greatest component of these deposits, ranging from 38 to 53%. Meanwhile, the percentage components of CLAY and SAND ranged from 12% to 22% and 14% to 26% respectively.

Turbine Delivery Route

According to the Teagasc soil mapping (www.gsi.ie), the junction accommodation works area is overlain by acid poorly drained mineral soils. The mapped subsoils at the junction accommodation works area comprise of till derived from Namurian sandstones and shales.

Meanwhile, the area at the Black Bridge is overlain by alluvium in the immediate vicinity of the river channel with acid poorly drained mineral soils are mapped adjacent to the river. The mapped subsoils

adjacent Black Bridge comprise of till derived from Namurian sandstones and shales to the north and bedrock outcrop to the south.



Legend

- EIAR Site Boundary
- Proposed Turbine Layout
- Proposed Turbine Hardstands
- Proposed New Roads
- Proposed Upgrades to Existing Roads
- Proposed Met Mast
- Proposed Temporary Construction Compounds
- Proposed Onsite 38kV Substation and Battery Storage Compound
- Proposed Grid Connection Route
- Proposed Peat Repository Areas
- Proposed Spoil Repository Areas
- Trial Pit Locations

Client: EDF Renewables Ireland Ltd.

Job: Seskin WF, Co. Carlow

Title: Wind Farm Site Investigation Map

Figure No: 8-3

Drawing No: P1599-0-0524-A4-803-00A | Scale: 1:10,000 | Drawn By: GA

Sheet Size: A4 | Project No: P1599-0 | Date: 01/05/2024 | Checked By: MG

HYDRO ENVIRONMENTAL SERVICES
22 Lower Main St
Dungarvan
Co.Waterford
Ireland
tel: +353 (0)58 44122
fax: +353 (0)58 44244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie

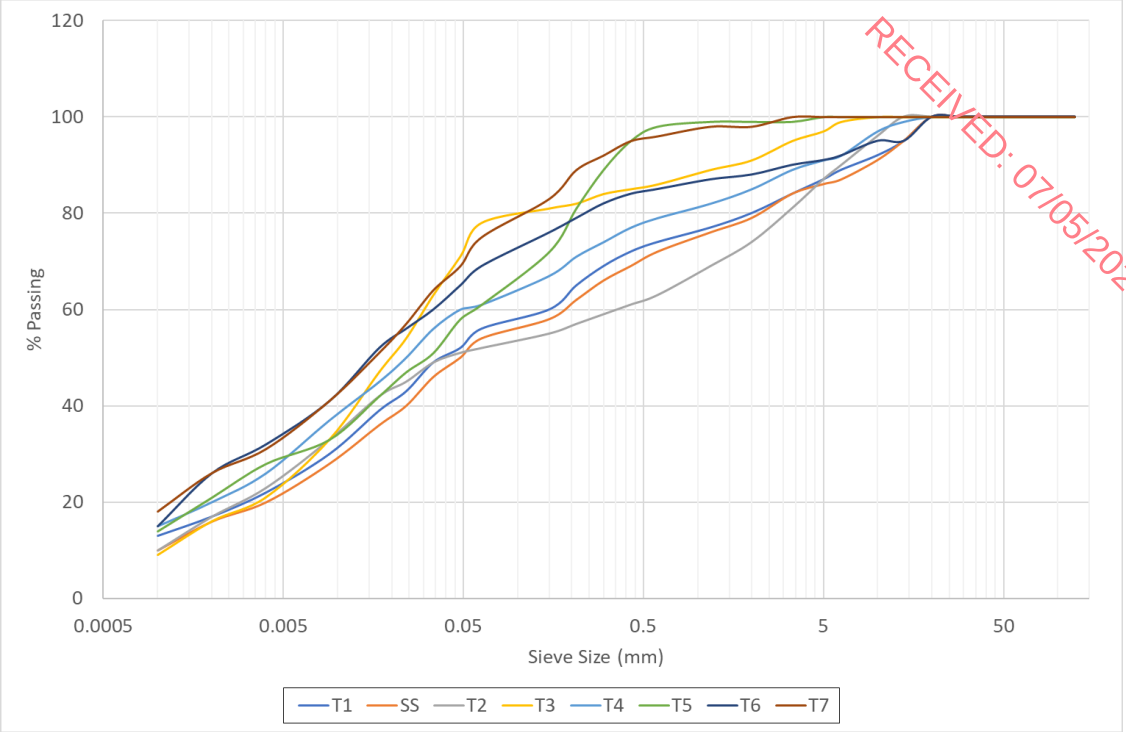


Figure 8-4: PSD Analysis of subsoils

8.3.3.2 Proposed Grid Connection Route

According to the Teagasc soil mapping (www.gsi.ie), the majority of Proposed Grid Connection Route is overlain by primarily acidic deep poorly drained mineral soils and acid shallow well drained mineral soils. In the north of the Proposed Grid Connection Route alluvium is mapped along the Coolcullen River. The southern section of the Proposed Grid Connection Route is overlain by acidic deep well drained mineral soils. Meanwhile, basic deep well drained mineral soils and basic poorly drained mineral soils are mapped in the vicinity of the existing Kilkenny 110kV substation. Mineral alluvium is also mapped along several watercourses in the vicinity of the Proposed Grid Connection Route.

In terms of subsoils, the GSI (www.gsi.ie) map shows the Proposed Grid Connection Route to be predominantly underlain by till derived from Namurian sandstones and shales and bedrock outcrop or subcrop. Meanwhile, subsoils in the vicinity of the existing Kilkenny 110kV substation are mapped as till derived from limestones.

Subsoils along the Proposed Grid Connection Route are shown in Figure 8-1 above.

8.3.4 Bedrock Geology

8.3.4.1 Proposed Wind Farm

Based on the GSI bedrock mapping (www.gsi.ie) the Proposed Wind Farm site is underlain by 3 no. bedrock geological formations. The mapped boundary between these formations is orientated approximately north to south.

The western section of the Proposed Wind Farm site is underlain by the Clay Gall Sandstone Formation which is comprised of feldspathic quartzitic sandstone. The GSI provide the following lithological description of the Clay Gall Sandstone Formation:

> *"It is composed of medium and fine quartz sand with some feldspar, well cemented by silica resulting in a non-porous rock of quartzitic character."*

The eastern section of the Proposed Wind Farm site is underlain by the Bregaun Sandstone Formation described as thick flaggy sandstone and siltstone. The GSI provide the following lithological description of the Bregaun Sandstone Formation:

> *"Thick grey flaggy bedded sandstones and siltstones with subordinate amounts of silty, grey and often micaceous shales. Cross-bedding and rippled surfaces are common and sheet slumps and sand volcanoes are recorded."*

A small area in the centre of the Proposed Wind Farm site is underlain by the Moyadd Coal Formation which comprises of shale siltstone and minor sandstone.

In terms of the key Proposed Wind Farm infrastructure a total of 4 no. turbines (T01, T04, T06 and T07), the met mast and the temporary construction compound adjacent to T06 are underlain by the Clay Gall Sandstone Formation. Meanwhile, 3 no. turbines (T02, T03 and T05) are underlain by the Bregaun Sandstone Formation. The proposed onsite 38kV substation, the battery storage compound, and the northern construction compound are underlain by the Moyadd Coal Formation.

Based on the GSI mapping, there are 2 no. faults mapped to underlie the Proposed Wind Farm site. 1 no. fault dissects the Proposed Wind Farm site in a north/northwest to south/southeast orientation and is mapped ~120m east of T06 and ~230m west of T01. A second northwest to southeast orientated fault is mapped in the southwest of the Proposed Wind Farm site. This fault is mapped ~500m southwest of T07.

The GSI do not map the presence of any bedrock outcrop within the Proposed Wind Farm site. The closest mapped bedrock outcrops are ~150m to the south and ~500m to the northeast.

A bedrock geology map is shown as Figure 8-5 below.

No competent bedrock was encountered at any of the intrusive site investigations. The trial pits completed at T02 and T03 encountered possible weathered bedrock at depths of 1.9 and 1.6mbgl respectively. These deposits were described as sandy silty angular gravel deposits. Bedrock outcrops were recorded in several of the streams draining the Proposed Wind Farm site and was consistent with the description provided by the GSI.

Turbine Delivery Route

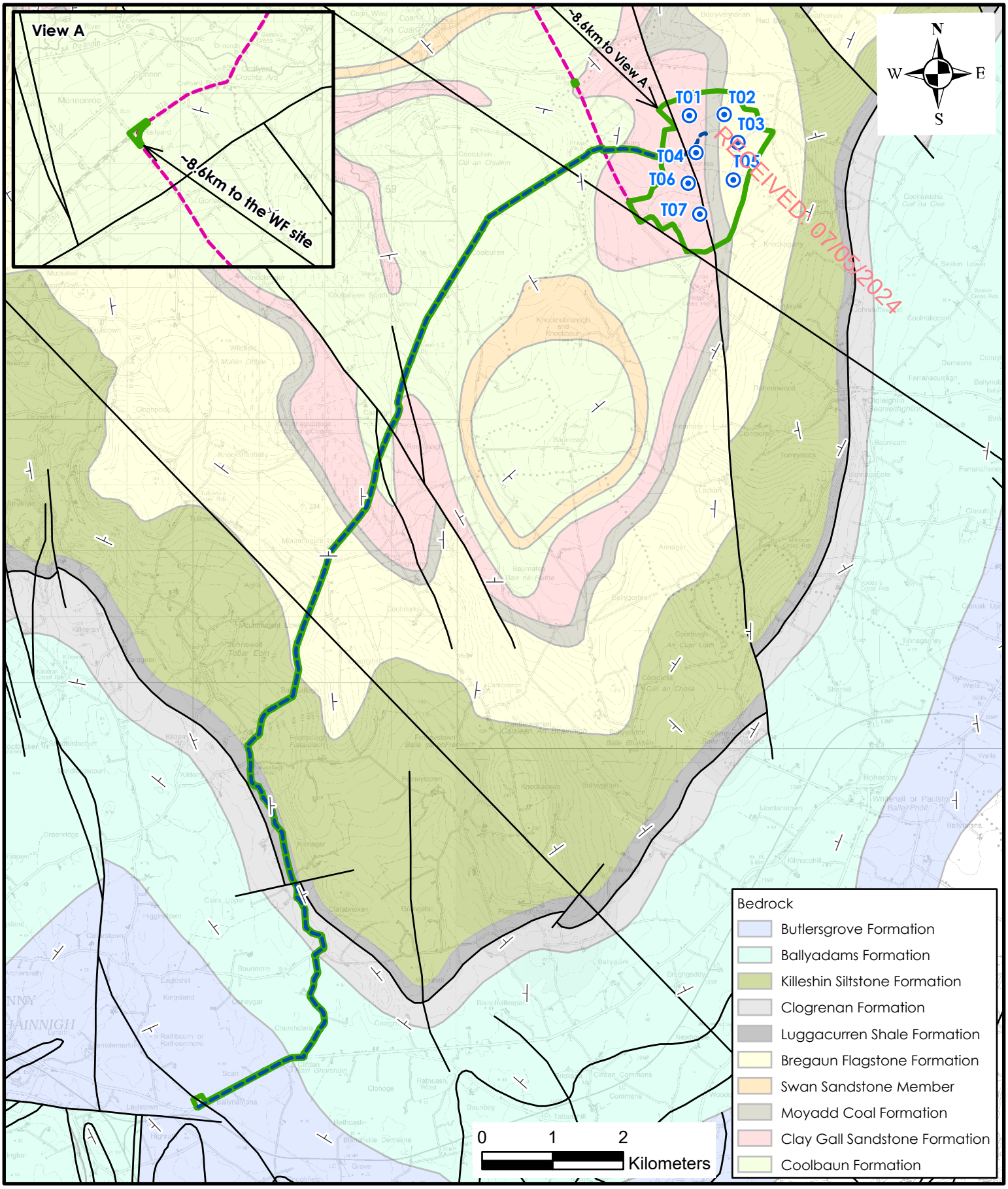
The junction accommodation works area is underlain by the Coolbaun Formation. Meanwhile, the Black Bridge lies at the boundary between the Clay Gall Sandstone Formation to the east and the Coolbaun Formation (shale and sandstone with thin coals) to the west. There are no faults or areas of bedrock outcrop mapped in these areas.

8.3.4.2 Proposed Grid Connection Route

In the vicinity of the Proposed Wind Farm site, the Proposed Grid Connection Route is underlain by the Clay Gall Sandstone Formation. As the Proposed Grid Connection Route travels southwest along the L30371 it passes over a large area of the Coolbaun Formation, comprising shale and sandstone with thin coals. The L30371 then passes over the Clay Gall Sandstone Formation again before crossing over a thin unit of Moyadd Coal Formation and the Bregaun Flagstone Formation. Further to the south the Proposed Grid Connection Route, along the L30371, is underlain by the Killeshin Siltstone Formation which consists of muddy siltstone and silty mudstone. The section of the Proposed Grid Connection Route along the L2627 is underlain by the Luggacurren Shale Formation (comprising mudstone and shale with chert and limestone), the Clogrenan Formation (comprising cherty, muddy, calcarenitic limestone) and the Ballyadams Formation (consisting of Crinoidal wackestone/packstone limestone). Meanwhile, the southern section of the Proposed Grid Connection Route along the R712 and in the vicinity of the existing Kilkenny 110kV substation is underlain by the Butlersgrove Formation which is described as a very dark-grey argillaceous limestone.

There are a total of 4 no. mapped faults along the Proposed Grid Connection Route. 1 no. northwest to southeast orientated fault is mapped underlying the L30371 in the townland of Coolcullen, Co. Kilkenny. Similar orientated faults are mapped under the L30371 in the townland of Reevanagh and further south in the townland of Ballysallagh. Finally, a small west/southwest to east/northeast fault is mapped beneath the L2627 in the townland of Clara Upper.

The bedrock geology along the Proposed Grid Connection Route is included in Figure 8-5.



Legend

- EIAR Site Boundary
- Proposed Turbine Layout
- Proposed Grid Connection Route
- Proposed Turbine Delivery Route
- Geological Linework

Structural Symbols

- Strike and dip of bedding, way up unknown

Client: EDF Renewables Ireland Ltd.

Job: Seskin WF, Co. Carlow

Title: Local Bedrock Geology Map

Figure No: 8-5

Drawing No: P1599-0-0524-A4-805-00A | Scale: 1:75,000 | Drawn By: GA

Sheet Size: A4 | Project No: P1599-0 | Date: 01/05/2024 | Checked By: MG

HYDRO ENVIRONMENTAL SERVICES
22 Lower Main St
Dungarvan
Co.Waterford
Ireland
tel: +353 (0)58 44122
fax: +353 (0)58 44244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie

8.3.5 Geological Resource Importance

8.3.5.1 Proposed Wind Farm

The GSI Online Database accessed via the Public Data Viewer (www.gsi.ie) does not record the presence of any active quarries or sand and gravel pits within the Proposed Wind Farm site. Old Leighlin Quarry, also known as Bannagagole Quarry, a dimension stone quarry, is mapped ~3.2km southeast of the Proposed Wind Farm site. Meanwhile, Clongrennane Quarry, a limestone quarry, situated ~4.5km to the northeast.

Furthermore, the GSI do not record the presence of any historic quarries or pits within the Proposed Wind Farm site. The closest mapped historic quarry/pit is situated ~650m southwest of the Proposed Wind Farm site in the townland of Ridge and is noted to have been active in the early to mid 20th century. No evidence of historic extraction activities was recorded during the site walkover surveys.

The GSI do not record any mineral localities within the Proposed Wind Farm site. However, several are recorded in the surrounding lands. Coal is noted to be present in the townlands of Agharue and Ridge to the west of the Proposed Wind Farm site.

The GSI online Aggregate Potential Mapping Database (www.gsi.ie) shows that the crushed rock aggregate potential of the Proposed Wind Farm site ranges from 'Very Low' to 'Very High'. Much of the Proposed Wind Farm site is noted as being of 'Very Low' to 'Low' potential. Some small areas of high potential are found in the southeast and in the west along the channel of a small watercourse. The bedrock at the Proposed Wind Farm site could be used on a "sub-economic" local scale for construction purposes. However, no borrow pits were encountered during walkover surveys. The bedrock has not previously been extracted due to the coverage of peat and till.

The Proposed Wind Farm site is generally not located within an area mapped for granular aggregate potential (i.e., potential for gravel reserves). There is a small area along the valley of a small watercourse in the west of the Proposed Wind Farm site which is mapped as having 'Very Low' potential. The peat and subsoil deposits at the Proposed Wind Farm site can be considered to be of 'Low' importance due to the largely thin occurrence, given the fact that peat is not designated in this area, and is significantly degraded in most places as a result of forestry plantations and associated drainage.

Turbine Delivery Route

There are no active quarries or active sand and gravel pits or mineral occurrences mapped in the area of the junction accommodation works or Black Bridge (www.gsi.ie).

The GSI online Aggregate Potential Mapping Database (www.gsi.ie) shows that the crushed rock aggregate potential at the junction accommodation work area is 'High' to 'Very High'. The crushed rock aggregate potential ranges from Moderate to 'Very High' in the vicinity of Black Bridge. The junction accommodation work area is not mapped as having potential for granular aggregate. Meanwhile, the area near Black Bridge is mapped as having 'Very Low' potential.

8.3.5.2 Proposed Grid Connection Route

There are no active quarries or active sand and gravel pits mapped along the Proposed Grid Connection Route (www.gsi.ie).

The GSI online Aggregate Potential Mapping Database (www.gsi.ie) shows that the crushed rock aggregate potential along the Proposed Grid Connection Route ranges from 'Low' to 'Very High'. The greatest potential is found in the south of the Proposed Grid Connection Route, along the L2627.

The majority of the Proposed Grid Connection Route is not mapped in an area for granular aggregate potential. However, a small section of the Proposed Grid Connection Route, along the Coolcullen River and along a small stream which runs parallel to the L2627 are mapped as having 'Low' potential for gravel reserves.

8.3.6 Geological Heritage Sites

8.3.6.1 Proposed Wind Farm

There are no recorded geological heritage sites within the Proposed Wind Farm site (www.gsi.ie).

The closest geological heritage site is Bannagagole Quarry County Geological Site (CGS) (Site Code: CW004) is located ~3.2km to the southeast of the Proposed Wind Farm site. The Bannagagole Quarry County Geological Site is described as a very large and deep working quarry; it is of importance as it exposes the Ballyadams Formation which hosts many interesting fossils (Carlow – County Geological Site Report). This CGS is recommended as a Geological Natural Heritage Area (NHA).

Old Rossmore CGS (Site Code: LS026) situated ~4.3km to the northeast of the Proposed Wind Farm site. This site is described as an abandoned coal mine and quarry with several large open pits, waste heaps, derelict plant and coal. The Old Rossmore CGS is of special interest as it provides good exposures of coal and coal bearing strata (Laois – County Geological site Report). This CGS is recommended as a Geological NHA.

Clongrenan Quarry CGS (Site Code: CW005) is located ~4.5km to the northeast. This geological heritage site is described as being a large deep working quarry which exposes the Lower Carboniferous Ballyadams Formation at the base of the section and passes upwards into the Clongrenan Formation (Carlow – County Geological Site Report). This CGS is recommended as a Geological NHA.

There are no other geological heritage sites within 5km of the Proposed Wind Farm site.

A map of local geological heritage sites is shown below as Figure 8-6.

Turbine Delivery Route

There are no geological heritage sites in the area of the junction accommodation works or in the vicinity of Black Bridge. Coolbaun Hill CGS (Site Code: KK012) is located ~1km to the south of the junction accommodation works area. The Coolbaun Hill CGS is described as a working open cast quarry and is of importance as it displays good sections of Upper Carboniferous limestones (Kilkenny - County Geological Site Report).

Meanwhile, Coolbaun Valley CGS (Site Code: KK016) is located ~1.8km south of the junction accommodation works area. The Coolbaun Hill Valley CGS is described as a disused coal mine within a small valley and is of importance for both its geological and cultural importance (Kilkenny - County Geological Site Report).

There are no other geological heritage sites mapped in close proximity to the junction accommodation works area or the Black Bridge.

8.3.6.2 Proposed Grid Connection Route

There are no geological heritage sites mapped along the Proposed Grid Connection Route. Geological Heritage Sites within 5km of the Proposed Grid Connection Route are described below.

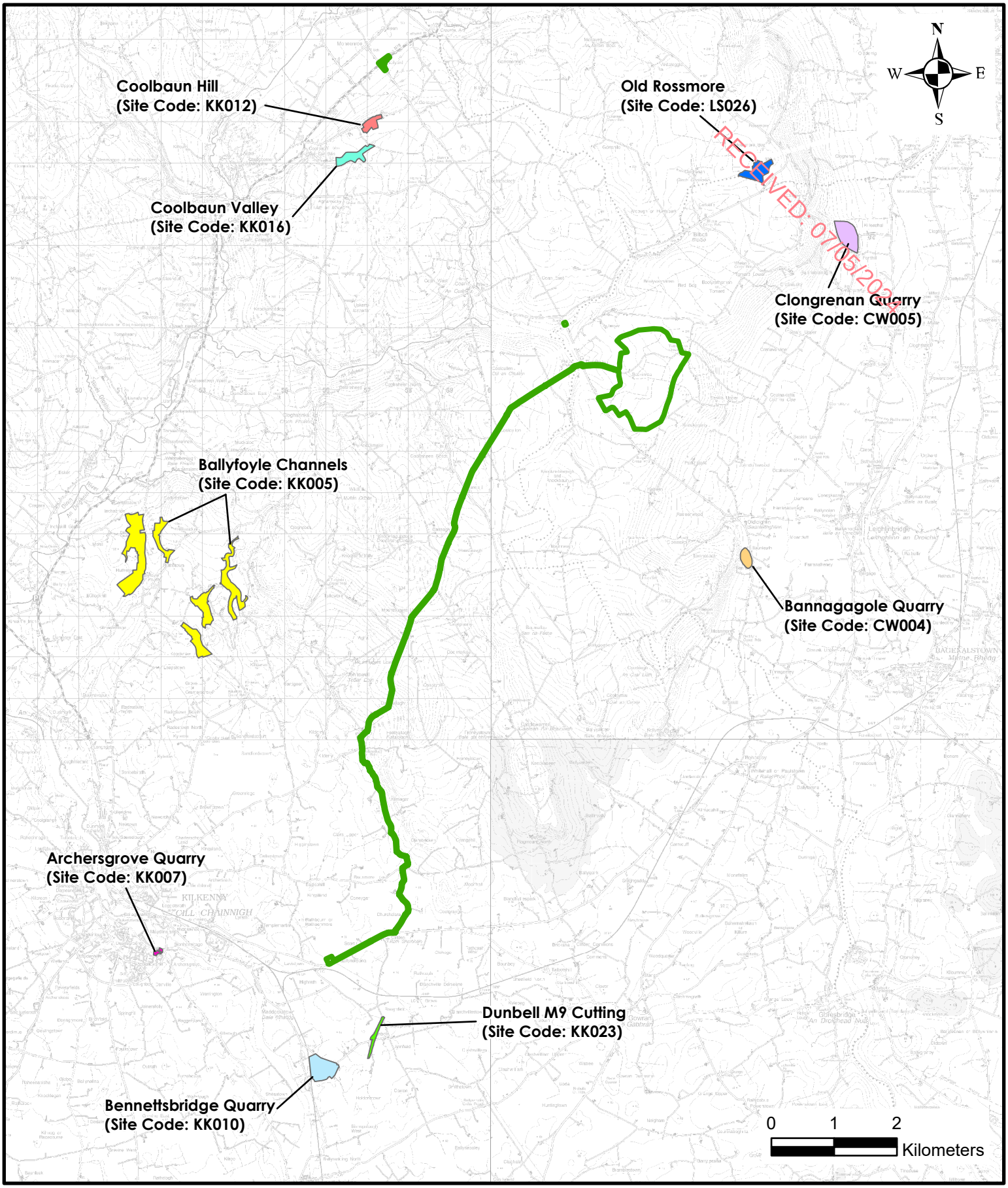
The Ballyfoyle Channels CGS (Site Code: KK005) is located ~4km west of the Proposed Grid Connection Route. The Ballyfoyle Channels CGS is described as a series of deeply incised channels

and is of significance due to the presence of glacial meltwater channels with exposures of siltstone and mudstone (Kilkenny – County Geological Site Report).

The Dunbell M9 Cutting CGS (Site Code: KK023) is located ~1.7km to the south of the existing Kilkenny 110kV substation. This CGS is described as a road cutting along the M9 with good exposures of the limestone rocks of the Butlersgrove Formation. The Dunbell M9 Cutting CGS exposes an anticline with two closely spaced faults. The site is of importance as it provides a well exposed section of Carboniferous limestones in Kilkenny (Kilkenny - County Geological Site Report).

Bennettsbridge Quarry CGS (Site Code: KK010) is located ~2.3km to the south of the existing Kilkenny 110kV substation. This CGS is of importance as it provides a very good example of dolomitised limestone (Kilkenny - County Geological Site Report).

Archersgrove Quarry CGS (Site Code: KK007) is located ~4.2km west of the existing Kilkenny 110kV substation. The Archersgrove Quarry CGS is a disused quarry and is thought to be the first location where Kilkenny Black Marble was quarried (Kilkenny - County Geological Site Report).



Legend

- EIAR Site Boundary

Geological Heritage Sites

- Archersgrove Quarry
- Ballyfoyle Channels
- Bannagagole Quarry
- Bennettsbridge Quarry
- Clogrenan Quarry
- Coolbaun Hill
- Coolbaun Valley
- Dunbell M9 Cutting
- Old Rossmore

Client: EDF Renewables Ireland Ltd.

Job: Seskin WF, Co. Carlow

Title: Geological Heritage Sites Map

Figure No: 8-6

Drawing No: P1599-0-0224-A4-806-00A

Scale: 1:120,000

Drawn By: GA

Sheet Size: A4

Project No: P1599-0

Date: 29/02/2024

Checked By: MG

HYDRO ENVIRONMENTAL SERVICES
22 Lower Main St
Dungarvan
Co.Waterford
Ireland
tel: +353 (0)58 44122
fax: +353 (0)58 44244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie

8.3.7 Soil Contamination

There are no known areas of soil contamination within the Proposed Wind Farm site or along the Proposed Grid Connection Route. During the site walkovers and site investigations, no areas of contamination concern were identified. No historic borrow pits which may have contaminated tailings were identified within the Proposed Wind Farm site.

According to the EPA online mapping (www.epa.ie), there are no licensed waste facilities or dump sites located within the Proposed Wind Farm site or along the Proposed Grid Connection Route. The closest EPA mapped waste facility is Powerstown landfill, located ~5.8km east of the Proposed Wind Farm site.

8.3.8 Peat Stability Assessment

8.3.8.1 Introduction

AFRY Ireland Limited was engaged by MKO to complete a Geotechnical and Peat Stability Assessment for the Proposed Project. The Geotechnical and Peat Stability Assessment Report (AFRY, 2024) is attached in Appendix 8-1.

The report investigates the geotechnical and peat-related characteristics of the Proposed Project site based on the published geology and data obtained from walkover surveys and site investigations. The report includes an analysis of the ground conditions to assess the risk of a peat slide occurring. This report was developed for the purposes of planning and detailed site investigations and further geotechnical assessments will be completed prior to construction.

Hydrological, hydrogeological and ecological factors were assessed in the Geotechnical and Peat Stability Assessment Report, and interactions between AFRY, HES and MKO were undertaken throughout the iterative design process. The Geotechnical and Peat Stability Assessment was done in accordance with Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments (PLHRAG, Scottish Government, 2017) and Guidelines for the Risk Management of Peat Slips (MacCulloch, 2006).

A constraints study was initially undertaken by the Environmental (MKO), Hydrological (HES) and Ecological (MKO) members of the project design team to determine the developable area of the Proposed Wind Farm site, prior to the site reconnaissance by engineering geologists/geotechnical engineers from AFRY and Causeway Geotechnical.

8.3.8.2 Hydrological Considerations

The hydrological factors with regard to peat stability were assessed using a combination of desk study data, aerial photography (historical and contemporary), topographic lidar data flow path drainage analysis, site walkovers, field drainage mapping and gouge coring. Detailed drainage maps were prepared along with hydrological constraints mapping for on-site drainage features and wet areas.

Many of the Pre-conditions as described by PLHRAG are hydrological in nature and are listed in the guidance as follows:

- Impeded drainage caused by a peat layer overlying an impervious clay or mineral base (hydrological discontinuity, especially an iron pan at the base of the peat deposit);
- A convex slope or a slope with a break of slope at its head (concentration of subsurface flow);
- Proximity to local drainage, either from flushes, pipes or streams (supply of water);
- Presence of historical and recent failure scars and debris;

- Presence of indicative tension cracks or features of compression (ridge, thrust or extrusion features); and
- Connectivity between surface drainage and the peat/impervious interface (mechanism for generation of excess pore pressures).

Identifying the above Pre-conditions at the Proposed Project site was a key part of the hydrological constraints assessment carried out in conjunction with project design team.

8.3.8.3 Peat Slides – Lessons Learned

This peat stability assessment has been undertaken taking into account peat failures that have occurred on peatland sites (such as recent failures at Shass Mountain 2020, Co. Leitrim and Meenbog 2020, Co. Donegal). The lessons learned from both peat slide events have been incorporated into the design of the Proposed Project and the construction methodologies to be implemented. The Meenbog failure occurred during the construction of a section of floating road on sidelong ground in an area of weak peat. This construction technique is not proposed on sidelong ground on the Proposed Wind Farm site. It is important that the existing site drainage is maintained during construction to avoid a similar failure to that on Shass Mountain, which occurred following heavy rainfall, and this is referenced in the Risk Assessments for the turbines/access roads (AFRY, 2024).

8.3.8.4 Peat Stability - Desk Study

The initial desk study involved consultation with all available relevant geological and hydrogeological online databases to collate and review the published geological information for the Proposed Project site and to inform the site investigations.

In relation to Proposed Wind Farm site the desks study found that:

- The Proposed Wind Farm site is predominantly underlain by till with some blanket peat (as detailed in Section 8.3.3.1);
- The bedrock geological formations underlying the Proposed Wind Farm site are detailed in Section 8.3.4.1;
- The GSI do not record the occurrence of any historic landslides within the Proposed Wind Farm site (www.gsi.ie). The closest recorded landslide is located ~14.3km to the north. The cause or mechanism of this landslide is unknown. However, given the distant location of this mapped historic landslide event to the Proposed Wind Farm site, the site-specific causes of that peat slide are deemed to not be pertinent to the Proposed Wind Farm site.
- The GSI Landslide Susceptibility Map (www.gsi.ie) classifies the probability of a landslide occurring. The landslide susceptibility of the Proposed Wind Farm site was classified by the GSI (2023) as being **"low"**.
- The Proposed Wind Farm site is underlain by Poor and Locally Important Bedrock Aquifers;
- Subsoil permeability is mapped by the GSI as Low (www.gsi.ie); and,
- Several watercourses traverse the Proposed Wind Farm site.

Furthermore, in order to characterise the slope conditions at the Proposed Wind Farm site, AFRY analysed slopes using a Digital Terrain Model derived from Bluesky (2018) orthophoto data. Table 2 of Appendix 8-1 presents the slope analysis at the Proposed Wind Farm site, with slopes ranging from 2° to 4.8°.

8.3.8.5 Site Investigations

The following surveys and investigations were completed to assess the susceptibility of the Proposed Wind Farm site to peat failure following the principles in PLHRAG:

- AFRY completed preliminary site walkover surveys between July 2023 and January 2024;
- Preliminary site investigations comprising of peat probing were completed by MKO between June and August 2023.
- Causeway Geotechnical Ltd completed additional site investigations (8 no. trial pits, 5 no. dynamic probes and 28 no. hand shear vanes) in November 2023.

The nature of the soils/subsoils encountered during these site investigations at the Proposed Wind Farm site are detailed in Section 8.3.3.1 above.

A walkover survey and inspection of the Proposed Grid Connection Route and TDR work areas identified no peat stability issues and therefore there was no requirement to carry out the detailed analysis as described below for the wind farm site (AFRY, 2024).

8.3.8.6 Quantitative Assessment

The purpose of the analysis was to determine the Factor of Safety (FoS) of the peat slopes at the Proposed Wind Farm site. The minimum required FoS is 1.3 based on BS6031:1981: Code of Practice for Earthworks (BSI, 2009). The assigned probability of instability associated with a given FoS value is described in Table 8-6 below. Hydrological and hydrogeological factors were also assessed in the Geotechnical and Peat Stability Assessment Report, and interaction between AFRY and HES was undertaken throughout the iterative design process.

No peat failures/landslides are recorded on the Proposed Wind Farm site which suggests that site conditions do not pre-dispose themselves to failures/landslides.

Based on the site-specific data:

- Peat Depths at the Proposed Wind Farm Site range from 0 to 2.7m with an average of 0.23m.
- The hand vane results indicate undrained shear strengths in the range 11 to 81kPa, with an average value of about 28kPa. The strengths recorded are typical of well-drained peat as is present at the Proposed Wind Farm site.

Table 8-6: Probability Scale for Factor of Safety.

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

8.3.8.6.1 *Quantitative Assessment Results*

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

An adverse combination of factors could potentially result in peat sliding. An adverse condition of one of the above-mentioned factors alone is unlikely to result in peat failure. The infinite slope model

(Skempton and DeLory, 1957) is used to combine these factors to determine a factor of safety for peat sliding. This model is based on a translational slide, which is a reasonable representation of the dominant mode of movement for peat failures.

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

- The undrained condition applies in the short-term during construction and until construction induced pore water pressures dissipate.
- The drained condition applies in the long-term. The condition examines the effect of in particular, the change in groundwater level as a result of rainfall on the existing stability of the natural peat slopes.

For the undrained and drained conditions, 3 no. surcharge loading conditions were considered during the stability analysis:

- No surcharge load (Condition 1);
- Surcharge load of 10kPa, equivalent to 1m of stockpiled peat (Condition 2); and,
- Surcharge load of 20kPa, equivalent to 2m of stockpiled peat (Condition 3).

Undrained Analysis

An analysis of peat stability was carried out at the key Proposed Project infrastructure locations for the undrained condition. As outlined above the undrained loading condition applies in the short-term during construction and until construction induced pore water pressures dissipate. The analysis in the Geotechnical and Peat Stability Assessment Report concentrated on areas where the peat depths recorded during the site investigations exceeded 0.5m. These deeper peat deposits were found near T01, T02, T03, T05 and T07. The undrained analysis results are presented in Table 8-7.

For the undrained analysis, the calculated FoS for the 3 no. load conditions was found to be in excess of 1.3 at all locations. This analysis indicates that there is a **low** risk of peat failure at the Proposed Wind Farm site.

Table 8-7: Factor of Safety Results (undrained condition)

Turbine No	No. of Analysis Locations	Factor of Safety for Load Condition		
		Condition 1	Condition 2	Condition 3
T01	4	128 - 575	38 - 164	21 – 96
T02	4	117 – 1,001	39 - 91	23 – 48
T03	4	48 - 322	27 - 175	19 – 121
T05	6	13 - 153	9 - 51	7 – 31
T07	9	115 - 338	38 - 78	23 - 44

Drained Analysis

An analysis of peat stability was carried out at the key Proposed Project infrastructure locations for the drained condition. As outlined above the drained loading condition applies in the long-term. The condition examines the effect of in particular, the change in groundwater level as a result of rainfall on

the existing stability of the natural peat slopes. Similar to the undrained analysis, the analysis for the drained conditions presented in the Geotechnical and Peat Stability Assessment Report concentrated on areas where the peat depths recorded during the site investigations exceeded 0.5m. The drained analysis results are presented in Table 8-8.

For the drained analysis, the calculated FoS for the 3 no. load conditions was found to be in excess of 1.3 at all locations. This analysis indicates that there is a **low** risk of peat failure at the Proposed Wind Farm site.

Table 8-8: Factor of Safety Results (drained condition)

Turbine No	No. of Analysis Locations	Factor of Safety for Load Condition		
		Condition 1	Condition 2	Condition 3
T1	4	18.8 – 29.9	6.0 – 8.5	3.5 – 5.0
T2	4	19.1 – 121.3	7.9 – 11.0	4.9 – 6.4
T3	4	5.4 – 36.1	2.9 – 8.3	2.0 – 4.7
T5	6	4.4 – 29.7	3.2 – 9.9	2.5 – 5.9
T7	9	25.7 – 53.4	8.9 – 12.5	5.2 – 7.7

8.3.8.6.2 *Summary of Quantitative Analysis*

The FoS obtained from both undrained and drained analyses is greater than 1.3 at all locations where peat depth exceeded 0.5m during peat probing. This indicates that the probability or the likelihood of peat slide occurrence within the Proposed Wind Farm site is deemed to be **low**.

8.3.8.7 Qualitative Assessment

In addition to the quantitative assessment of peat stability presented above, AFRY completed a qualitative assessment of peat stability at the Proposed Wind Farm site based on the Guidelines for the Risk Management of Peat Slips (MacCulloch, 2006).

This assessment is based on 8 no. factors (slope angle, peat depth, moisture content, cracking, underground hydrology, surface hydrology, historical slides and weather). Each of these factors have been identified as contributory factors to peat slides.

For example, the probability of different peat strengths (shear strengths) and different peat depths contributing to peat slides are detailed in Table 8-9 and Table 8-10 below. Similar tables exist for the other 6 no. factors and are detailed in Section 7.3.1 of the Geotechnical and Peat Stability Assessment (Appendix 8-1).

The data within these eight principal factors, some of which is not numeric, is used to derive a single representative value for individual areas of the Proposed Wind Farm site. The methodology has been adopted from Guidelines for the Risk Management of Peat Slips (MacCulloch 2006) in which the measured value of the principal factors is linked to the likelihood of contributing to a peat slide. Table 8-11 presents the probability values for the likelihood of a peat slide occurring based on the Guidelines for the Risk Management of Peat Slips (MacCulloch, 2006).

Table 8-9: Probability of Shear Strength Contributing to a Peat Slide

Probability of a Peat Slide	Shear Strength (kPa)
Very Likely	≤5
Likely	5 – 10
Probable	10 – 12.5
Unlikely	12.5 – 15
Negligible	≥15

Table 8-10: Probability of Peat Depths Contributing to a Peat Slide

Probability of a Peat Slide Occurring	Peat Depth (m)
Very Likely	0 – 0.5
Likely	0.5 – 1.0
Probable	1.0 -1.5
Unlikely	1.5 – 2.0
Negligible	≥2

Table 8-11: Probability Values for Likelihood of Peat Slide Occurring)

Probability of a Landslide Occurring		AFRY Probability Terminology
Very Likely	>75%	High
Likely	50-75%	Medium
Probable	25-50%	
Unlikely	10-25%	Low
Negligible	<10%	Negligible

8.3.8.7.1 *Qualitative Assessment Results*

The qualitative assessment was based on the likelihood of the occurrence of a peat slide based on each of the 8 no. contributory factors and was determined for individual areas of the Proposed Wind Farm site from the available information (desk study info and site investigation data).

After considering the 8 no. contributory factors and the site-specific conditions at the Proposed Wind Farm site, the probability of a peat slide occurring has been assessed and is summarised in Table 8-12. Similar to the quantitative analysis, this was only completed in areas where 0.5m of peat was recorded.

Based on this qualitative assessment, the Proposed Project infrastructure are mostly located in areas with a **'Low'** probability of a peat slide. The exception is the access road to T05 where the probability of a peat slide occurring has been assessed as being 'Medium'. The access road to T05 has been assessed as having a greater risk in the qualitative assessment due to the occurrence of deeper peat. The access road to T5 has an average peat depth of 0.73m in comparison to the other analysed locations where the average peat depths range from 0.15 to 0.53m. Based on Table 8-10, the peat depth at this location is likely to contribute to a peat slide (MacCullogh, 2006). In addition, the peat strength along this section of access road is lower (10kPa to 12.5kPa) in comparison to other locations (12.5kPa to >15kPa). Based on Table 8-9, the strength of the peat here is probably likely to contribute to a peat slide.

Table 8-12: Summary Results of Qualitative Risk Assessment (AFRY, 2024)

Turbine No./ Location	Probability of a Peat Slide Occurring
T1	23% (Low)
T2	24% (Low)
T3	24% (Low)
T5	24% (Low)
T7	23% (Low)
Spur to T1	23% (Low)
Spur to T2	23% (Low)
Spur to T3	23% (Low)
Spur to T5	28% (Medium)
Spur to T7	23% (Low)

8.3.8.8 Peat Stability and Risk Assessment Summary

The findings of the Geotechnical and Peat Stability Assessment showed that the Proposed Wind Farm site has an acceptable margin of safety and is suitable for the Proposed Project.

When a quantitative assessment for undrained condition was carried out, FoS ranged from 7.5 to 95.9 for 2m peat surcharge. The drained analysis resulted in FoS values between 2.0 to 7.7 for 2m peat surcharge. FoS values higher than 1.3 are deemed to have a negligible probability of instability once mitigation/control measures are implemented.

A qualitative assessment of the peat stability returned a low risk at all locations, except along the spur road to T05, where it was assessed as medium. This was based on peat depths and lower shear strength.

The report includes recommendations and mitigation measures for construction work in peatlands to ensure that all works adhere to an acceptable standard of safety. The risk rating at all areas at the Proposed Wind Farm site is reduced to low provided all mitigation measured are adhered to. In summary, the findings of the Geotechnical and Peat Stability Assessment indicate that the Proposed Wind Farm site has an acceptable margin of safety and is suitable for the Proposed Project.

8.4 Receptor Sensitivity and Importance

Based on the criteria set out in Table 8-2 above, the soils and peat at the Proposed Wind Farm site can be classed as being of low importance as the overlying peat deposits are not designated in this area and are significantly degraded as a result of the commercial forestry operations and associated drainage.

The bedrock geology underlying the Proposed Wind Farm site can be classed as being of medium importance where the bedrock could be used on a sub-economic scale.

The land, peat, soils and bedrock geological formations underlying the Proposed Wind Farm site and the Proposed Grid Connection Route will be included in the impact assessment due to their proximal location to the Proposed Project and the potential direct effects that the Proposed Project may have on these receptors.

All geological heritage sites have been screened out of the impact assessment due to their distal location from the Proposed Project. There is no potential for effects to occur on these geological heritage sites.

8.5 Characteristics of the Proposed Project

The Proposed Project is defined in full in Chapter 4.

The Proposed Project will involve removal of peat and subsoils for the construction of access roads, internal cable network, hardstanding emplacement, turbine foundations, substation, crane hardstands, construction compounds, drainage works and met mast installation. Rock for construction purposes will be imported from nearby quarries and sand and gravel pits.

Generally, for constructing any structure or platform foundation, such as a turbine base, hardstand or substation, removing all soft material is required to a depth where a suitable bearing material is encountered. Rock breaking may be required at some of the turbines and hard-standing locations to create the reduced foundation level and the levelling required for construction. The material excavated is required to be properly managed and stored and should be re-used in other elements of the Proposed Wind Farm design.

During turbine construction, peat, where present, will be permanently excavated to the substrate to make room for the concrete turbine foundation and a small working area surrounding the foundation footprint. Breaking and excavation of bedrock may be required where it is encountered at shallow depths to achieve the reduced foundation level and level surface required by design. Turbine base excavations of 25.5m in diameter are proposed (23.5m turbine diameter plus 1m working area), with detailed foundation design dictated by the local ground conditions and the requirements of the turbine supplier. The plan area for the material to be removed will be dictated by the enabling temporary works design, allowable excavation angle and the mean peat and overburden depths across each turbine location. The design of the turbine base foundations is subject to further ground investigation and the detailed design designer's assessment.

Similarly, all turbine crane hardstands will be required to be founded on a suitable bearing material requiring the excavation of all peat and other soft ground materials, where present. The platform will be constructed in the excavated area using a suitable specified engineered stone fill. Following the placement of the platform, the excavated peat can be re-used to batter the platform edges and landscape the platform back into the existing topography.

The quantities of peat and spoil, requiring management at the Proposed Project site has been calculated, as presented in Table 8-13 below. The quantities were calculated by AFRY as part of the Peat and Spoil Management Plan included as Appendix 4-2 of this EIAR.

The total volumes of peat and spoil requiring placement/reinstatement on Proposed Wind Farm site is estimated to be 22,338m^3 and 34,104m^3 respectively (refer to Table 8-13 below). A contingency factor of 15% has been applied and is included to the excavated spoil volumes, and a bulking factor of 20% has been used for excavated peat volumes to allow for expected increase in volume upon excavation and to allow for a variation in ground conditions across the site.

It is proposed to manage any excess overburden generated through construction activities within the Proposed Project site, in 8 no. peat deposition areas and 6 no. spoil deposition areas, in linear berms along access roads where appropriate, and landscaping around turbine bases. A detailed breakdown of the capacity of the peat and spoil management areas within the Proposed Project site is shown in Table 8-14 below and is further detailed in the Peat and Spoil Management Plan (Appendix 4-2).

The total volume of peat requiring management on site is estimated at 22,338m^3. This material will be excavated and deposited in the peat management areas, with a total capacity volume of 24,700m^3, around turbine bases and hardstands, sidecast along access roads with gentle gradients, and landscaping. The total volume of spoil requiring management on site is estimated at 34,103m^3. This material will be excavated and deposited in the spoil management areas, with a total capacity volume of 40,845m^3, around turbine bases and hardstands, for ballast and landscaping. As such, there is

enough capacity in the peat and spoil management areas within the Proposed Project site, for the total volumes of peat and spoil requiring management for the Proposed Project.

The total volume of spoil to be managed for the Proposed Grid Connection Route has been taken account in the total spoil volume requiring management for the Proposed Project. As detailed above, there is capacity for the total volume of spoil requiring management for the Proposed Project in the spoil repository areas within the Proposed Wind Farm site. However, some of the Proposed Grid Connection Route materials will go to an appropriate licenced facility as required. This is dependent on the road makeup at locations along the Proposed Grid Connection Route and the distance from the Proposed Grid Connection Route to the Proposed Wind Farm site. The main contractor will determine the appropriate location for management of arisings from the Proposed Grid Connection Route.

In order to facilitate the construction of the Proposed Project, all crushed stone, hardcore materials and ready-mix concrete that will be required during the construction phase will be sourced from local, appropriately authorised quarries.

Table 8-13: Peat and Spoil Repository Areas

Infrastructure Element	Description	Excavated Peat Volume (m^3)	Excavated Spoil Volume (m^3)
7 no. turbines and associated hardstands	25.5m diameter excavation footprint for turbine foundation (23.5m turbine diameter plus 1m working area all around) with 50m x 25m plus 15m x 3m hardstand areas	17,178	18,521
Access Roads	Assumed 5m running surface with 6.8m wide development footprint	3,240	12,075
Temporary Construction Compounds	Areas 80m x 50m and 90m x 25m	1,800	1,725
Substation and BESS Compound	Area 90m x 40m	120	1,495
Met Mast	Area 25m x 15m	0	288
Total		**22,338**	**34,103**
		56,442	

Table 8-14: Summary of Peat and Spoil Placement/Reinstatement

Location	Peat Volume (m^3)	Spoil Volume (m^3)
Peat/Spoil deposition around turbines and hardstands within clear fell areas	23,360	36,845
Peat sidecasting	1,000	-
Peat landscaping	340	-

Location	Peat Volume (m^3)	Spoil Volume (m^3)
Reuse of Spoil around turbine bases	-	4,000
Total Volume (m^3)	**24,700**	**40,845**

8.6 Likely Significant Effects and Associated Mitigation Measures

8.6.1 Do Nothing Scenario

If the Proposed Project was not developed, the Proposed Wind Farm site will continue to function as it does at present, with no changes made to the current land-use of commercial forestry and agricultural land. The forestry operations would continue at the Proposed Wind Farm site and may be extended in some areas. The forestry operations would comprise felling and replanting of certain areas depending on the productivity of each area. All forestry operations would continue to conform with the current best practice Forest Service regulations, policies and guidance documents as well as Coillte and the Department of Agriculture, Food and the Marine (DAFM) guidance documents. The impact of this is considered neutral in the context of the EIAR.

If the Proposed Project were not to proceed, the opportunity to capture an even greater part of County Carlow's valuable renewable energy resource would be lost, as would the opportunity to further contribute to meeting Government and EU targets for the production and consumption of electricity from renewable resources and the reduction of greenhouse gas emissions. The opportunity to generate local employment and investment and to diversify the local economy would also be lost.

8.6.2 Construction Phase - Likely Significant Effects and Mitigation Measures

The likely effects of the Proposed Project and mitigation measures that will be put in place during the construction phase to eliminate or reduce them are outlined below.

8.6.2.1 Effects on Land (Land-Take)

The Proposed Project includes the construction of 7 no. turbines, associated hardstand areas, 2 no. temporary construction compounds, an onsite substation and battery storage compound, new access roads and upgrades to the existing road network. The Proposed Project has a total footprint of 7.3ha.

A total of 19ha of forestry will be permanently felled within and around the Proposed Project. The permanent footprint of the Proposed Project (7.3ha) will result in the permanent loss of both agricultural land and forestry plantations, which will be replaced by turbine bases, hardstand areas, access roads and other related infrastructure. The Proposed Project construction works will also result in local topographic changes with the removal of overburden and bedrock.

No effects on land will occur along the Proposed Grid Connection Route as all works will occur within the carriageway of the existing public road network. The works will result in the excavation of a narrow

trench to accommodate the cabling. This trench will be reinstated once the cabling is emplaced with a comparable ground surface (tarmacadam).

There will be no effects on the lands adjoining the Proposed Project site.

With regards to the junction accommodation work areas along the TDR, there will be a loss of 1.32ha of agricultural land which will be replaced by a new road to facilitate the delivery of the turbine components. There will be no loss of land associated with the proposed strengthening works at Black Bridge.

Pathways: Excavation and infrastructure construction.

Receptors: Land (i.e. the land upon which the Proposed Project will occur).

Pre-Mitigation Potential Effect: Negative, slight, direct, permanent, likely effect on land (land-take) within the Proposed Wind Farm site.

Negative, imperceptible, direct, permanent, likely effect on land (land-take) along the Proposed Grid Connection Route.

Mitigation Measures / Impact Assessment: The Proposed Project layout has been designed to, where possible, utilise the existing road network at the Proposed Wind Farm site, therefore reducing the area of the Proposed Wind Farm site which will be altered from existing land cover to site access roads.

The loss of ~19ha of coniferous forestry associated with felling to facilitate the Proposed Wind Farm and 7.3ha of agricultural land and coniferous forestry associated with the permanent development footprint will not have a significant effect on land at the Proposed Wind Farm site. The permanent development footprint represents a change in landcover of 2% of the total Proposed Project site area (370ha). Meanwhile, the total area to be felled represents 5.1% of the Proposed Project site area.

Given the local undulating topography, any change in the topography is likely to be minimal in the overall landscape.

Post Mitigation Residual Effect: The Proposed Wind Farm will result in the loss of coniferous forestry and agricultural lands which will be replaced by turbine bases, hardstands and other proposed infrastructure. This will result in a permanent change to land at these locations. However, due to the relatively small footprint of the Proposed Project infrastructure on a site scale and even more so on a local scale the residual effect is considered to be negative, direct, slight, permanent, likely effect on land (land-take).

Significance of Effects: For the reasons outlined above (small development footprint), no significant effects on land (land-take) will occur.

8.6.2.2 Peat, Subsoil and Bedrock Excavation

Excavation of peat, subsoil and bedrock will be required for the Proposed Project works during the construction phase including:

- The installation of new proposed access roads and the upgrade of existing site access roads will require the excavation of 3,240m^3 of peat and 12,075m^3 of spoil materials (these volumes include works along TDR route);
- Construction of 7 no. turbine foundations and associated turbine hardstands will require the excavation of 17,178m^3 of peat and 18,521m^3 of spoil;
- Construction of 1 no. met mast will require the excavation of 288m^3 of spoil;
- Construction the onsite substation and battery storage compound will require the excavation of 120m^3 of peat and 1,495m^3 of spoil;

- Construction of the 2 no. temporary construction compounds will require the removal of 1,800m^3 of peat and 1,725m^3 of spoil; and,
- Insertion of the Proposed Project drainage network.
- Construction of the Proposed Grid Connection Route from the onsite 38kV substation to the existing Kilkenny 110kV substation – excavation of material will be reinstated and any surplus material arising will be disposed of in a nearby licensed waste facility and/or managed on site.

These construction phase activities will result in the permanent removal and relocation of in-situ peat and subsoil at most excavation locations. Estimated volumes of peat, subsoils and bedrock to be relocated are summarised above in Table 8-13. It is estimated that the total volume of peat and spoil excavated will be 56,442m^3. HES note that earthworks of this type, scale and magnitude have been granted permission and successfully completed at similar sites around the country.

However, there will be no loss of peat or spoil, as it will be relocated within the Proposed Project site. It is proposed to manage any excess overburden generated through construction activities within the Proposed Project site, in 8 no. peat repository areas and 6 no. spoil repository areas, in linear berms along access roads where appropriate, and landscaping around turbine bases.

Excavation of material will also be required at the junction accommodation works along the TDR. The volume of material requiring excavation is included in the volumes presented in Table 8-13. Any surplus material arisings will be managed locally.

Excavation of subsoils will also be required along the Proposed Grid Connection Route. Where suitable, these deposits will be reinstated back into the trench and there will be no requirement to store these materials elsewhere. However, some materials will be disposed of an appropriately licenced facility, and some will be stored at the Proposed Wind Farm site.

Pathway: Extraction/excavation.

Receptor: Peat, subsoil and bedrock with the Proposed Wind Farm site and the Proposed Grid Connection Route.

Pre-Mitigation Potential Effect: Negative, slight/moderate, direct, likely, permanent effect on peat, subsoil and bedrock due to relocation within the Proposed Wind Farm site.

Negative, slight, direct, permanent, likely effect on soils and subsoils along the Proposed Grid Connection Route.

Proposed Mitigation Measures by Design:

Proposed Wind Farm site:

- Placement of turbines and associated infrastructure in areas of shallow peat and suitable ground conditions (based on detailed site investigation data);
- The peat and subsoil which will be removed during the construction phase will be localised to the Proposed Wind Farm infrastructure turbine location, substation and temporary compounds and access roads;
- The Proposed Project has been designed to avoid sensitive habitats;
- A minimal volume of peat, subsoil and rock will be excavated and removed to allow for infrastructure works to take place in comparison to the total volume of these materials present on the site due to optimisation of the Proposed Project design;
- At the identified peat and spoil repository areas, the vegetative topsoil layer will be removed to allow for spoil to be placed and upon reaching the recommended height, the vegetative topsoil layer will be reinstated;

- The identified spoil management areas will be developed in a phased approach, with the topsoil removed and temporarily stockpiled within the defined area while the spoil it being placed. The stockpiled topsoil will then be reinstated over the placed spoil, and the exercise will continue within the same spoil management area until the area is full;
- The placement of spoil will be restricted to a maximum height of 1.0m, subject to confirmation by the Geotechnical Engineer;
- Where practical, the surface of the placed spoil is shaped to allow efficient run-off of surface water. Where possible, shaping of the surface of the spoil will be carried out as placement of spoil within the area progresses. This will reduce the likelihood of debris run-off and ensure stability of the placed spoil;
- Finished/shaped side slopes of the placed spoil will be not greater than 1 (v): 2 (h) in the dedicated spoil management zones and not greater than 1 (v): 1 (h) alongside access tracks;
- Inspections of the spoil management areas will be made by a Geotechnical Engineer through regular monitoring of the works. The appointed contractor will review work practices at spoil management areas when periods of heavy rainfall are expected so as to prevent excessive dirty water runoff from being generated;
- An interceptor drain will be installed upslope of the identified spoil management areas to divert any surface water away from these areas;
- Silt fences and double silt-fences will be emplaced down-gradient of spoil management areas and will remain in place throughout the entire construction phase, or until reseeding has been established to a sufficient level;
- The surface of the deposited spoil will be profiled to a gradient to be agreed with the Geotechnical Engineer and vegetated or allowed to vegetate naturally as indicated by the Project Ecologist;
- All the above-mentioned general guidelines and requirements will be confirmed by the Geotechnical Engineer prior to construction;
- The material will be backfilled into the spoil management areas and will be spread evenly across the area;
- It will be compacted to reduce air voids and reduce the migration paths for infiltration by precipitation. This will reduce the amount of potentially silt laden surface water run-off from these spoil management areas. Excavated soils/subsoils shall be excavated and stored separately to topsoil; this will prevent mixing of materials and facilitate reuse afterwards;
- All materials which require management will be stockpiled at low angles (< 5-10˚) to ensure their stability and secured using silt fencing where necessary. This will help to mitigate erosion and unnecessary additions of suspended solids to the drainage system; and,
- Spoil management will take place within a minimal distance of each turbine to avoid excessive transport of materials within the site.

Proposed Grid Connection Route:

- Soils and subsoils excavated along the Proposed Grid Connection underground cabling route will be temporarily stored in covered stock piles along the edge of the road carriageway;
- Once the emplacement of the 38kV cable has been completed, the stored soils and subsoils will be reinstated, with the minimal amount of compaction required to level the top surface; and,
- The tarmacadam road surface will be replaced with the same design standard as the surrounding carriageway.

Post Mitigation Residual Effect: The granular subsoils and peat at the Proposed Wind Farm site can be classified as of “Low” importance and the bedrock of “Medium” importance.

The overall Proposed Project site area is extensive (370ha) while the permanent Proposed Project footprint (7.23a) is approximately 2% of the overall area. The negative effect is the disturbance and relocation of 56,441m^3 of peat and spoil. The design measures incorporated into the Proposed Project as described above and detailed further in the Peat and Spoil Management Plan (Appendix 4-2 of this EIAR), combined with the 'low' importance of the peat/soil and subsoil deposits and the 'medium' importance of the local bedrock means that the residual effect will be - Negative, slight, direct, likely, permanent effect on peat, subsoils and bedrock due to disturbance and relocation within the Proposed Wind Farm site.

The cohesive and granular soil/subsoil along the Proposed Grid Connection Route are classified as being of 'low' to 'moderate' importance. Following the excavation and construction of the grid connection, the area excavated will be reinstated with a comparable ground cover. The residual effect is considered to be a negative, imperceptible, direct, likely, permanent effect.

Significance of Effects: For the reasons outlined above, no significant effects on peat, subsoils and bedrock will occur.

8.6.2.3 Contamination of Soil/Subsoil by Leakages and Spillages

Accidental spillage during refuelling of construction plant with petroleum hydrocarbons is a pollution risk at the Proposed Project site. The accumulation of small spills of fuels and lubricants during routine plant use can also be a significant pollution risk. Hydrocarbon has a high toxicity to humans, and all flora and fauna, including fish, and is persistent in the environment. Large spills or leaks have the potential to result in significant effects (i.e. contamination of peat, subsoils and pollution of the underlying aquifer) on the geological and water environment. Additionally, waste tar, removed from the road hardstanding along the Proposed Grid Connection Route has the potential to affect soil/subsoil geochemistry.

Pathway: Peat and subsoil and underlying bedrock pore space.

Receptor: Peat and subsoil, bedrock.

Pre-Mitigation Potential Effect: Negative, slight, direct, short-term, unlikely effect on peat, subsoils and bedrock.

Proposed Mitigation Measures:

- On-site re-fuelling will be undertaken using a double skinned bowser with spill kits kept on site for accidental leakages or spillages;
- Only designated trained operatives will be authorised to refuel plant on-site;
- Taps, nozzles or valves associated with refuelling equipment will be fitted with a lock system;
- All fuel storage areas will be bunded appropriately for the duration of the construction phase. All bunded areas will be fitted with a storm drainage system and an appropriate oil interceptor. Ancillary equipment such as hoses, pipes will be contained within the bunded area;
- Fuel and oil stores including tanks and drums will be regularly inspected for leaks and signs of damage;
- The electrical control building (at the substation) will be bunded appropriately to the volume of oils likely to be stored and to prevent leakage of any associated chemicals to groundwater or surface water. The bunded area will be fitted with a storm drainage system and an appropriate oil interceptor;
- The plant used during construction will be regularly inspected for leaks and fitness for purpose;
- All waste tar material arising from works on hard top roads will be removed off site and taken to licenced waste facility and,

- An emergency response plan for the construction phase to deal with accidental spillages is contained within the Construction and Environmental Management Plan (which is contained in Appendix 4-4).

Post Mitigation Residual Effect: The use and storage of hydrocarbons and small volumes of chemicals is a standard risk associated with all construction sites. Proven and effective measures to mitigate the risk of spills and leaks have been proposed above and will break the pathway between the potential source and the receptor. The residual effect will be - Negative, imperceptible, direct, short-term, low unlikely effect on peat and subsoils and bedrock.

Significance of Effects: For the reasons outlined above, and with the implementation of the listed mitigation, no significant effects on peat, subsoils and bedrock will occur.

8.6.2.4 Erosion of Exposed Subsoils and Peat During Construction of Proposed Wind Farm

There is a high likelihood of erosion of peat and spoil during its excavation and during landscaping works at the Proposed Wind Farm site. The main impacts associated with this aspect is to the water environment, and therefore this aspect is further assessed in detail in Chapter 9 Water of this EIAR.

Pathway: Vehicle movement, surface water and wind action.

Receptor: Peat and subsoil at the Proposed Wind Farm site.

Pre-Mitigation Potential Effect: Negative, slight, direct, short-term, likely effect on peat and subsoils by erosion and wind action.

Proposed Mitigation Measures:

- Peat removed from the Proposed Wind Farm infrastructure footprint will be reinstated within the Proposed Wind Farm site;
- The upper vegetative layer (where still present) of excavated peat will be stored with the vegetation part of the sod facing the right way up to encourage growth of plants and vegetation at the surface of the stored peat within the peat repository areas;
- Re-seeding and spreading/planting will also be carried out in the peat and spoil management areas;
- In forested areas brash/bog mats will be put in place to support vehicles on soft ground, reducing peat and mineral soils erosion and avoiding the formation of rutted areas, in which surface water ponding can occur. Brash mat renewal will take place when they become worn;
- Temporary drainage systems will limit runoff impacts during the construction phase; and,
- A full Peat and Spoil Management Plan for the Proposed Project is detailed in Appendix 4-2.

Post Mitigation Residual Effect: Peat soils and spoil can be eroded by vehicle movements, wind action and by water movement. To prevent this all excavation works will be completed in accordance with a detailed Peat and Spoil Management Plan, material will remain within the Proposed Wind Farm site and reseeding and planting will be completed to bind landscaped peat and spoil together. Following implementation of these measures the residual effects will be - Negative, slight, direct, short-term, likely effect on peat and subsoils by erosion and wind action.

Significance of Effects: For the reasons outlined above, no significant effects on soils, subsoils or bedrock will occur.

8.6.2.5 Erosion of Exposed Subsoils During Construction of the Proposed Grid Connection Route

Erosion of soil/subsoil by the pathways listed below, can have the effect of reducing the overall volume of soil/subsoil at the site, with the potential for some eroded subsoils to reach watercourses, leading to water quality issues such as high turbidity. Erosion of soils/subsoils may occur at any works area where excavation is ongoing (i.e., along the Proposed Grid Connection Route).

Pathway: Vehicle movement, surface water and wind action along the Proposed Grid Connection Route.

Receptor: Soil, subsoil & weathered bedrock along the Proposed Grid Connection Route.

Pre-Mitigation Potential Impact: Negative, direct, slight, high probability impact on soil, subsoils and bedrock.

Proposed Mitigation Measures:

- Soil/subsoil removed from the trench will be transported to the on-site spoil management areas or to a local licenced facility.
- Temporary drainage systems will limit runoff impacts during the construction phase.
- The Proposed Grid Connection Route will be constructed in a stepwise manner along its length. This will minimise the time any particular section of the Proposed Grid Connection Route cabling trench is open before being reinstated.

Residual Effects: Soil and subsoil can be eroded by vehicle movements, wind action and by water movement. To prevent this, all excavation works will be temporary and silt fencing will be used where appropriate near surface watercourses. Following implementation of these measures the residual effected is considered to be - Negative, slight, direct, likely effect on soil and subsoils, and possibly bedrock.

Significance of Effects: For the reasons outlined above, no significant effects on soils, subsoils or bedrock relating to the Proposed Grid Connection Route will occur.

8.6.2.6 Erosion of Exposed Soils/Subsoils and Peat During Tree Felling

Tree felling is a component of the proposed works at the Proposed Wind Farm site, with ~19ha of felling proposed to facilitate the Proposed Wind Farm.

During felling operations there is a high likelihood of erosion of peat and spoil due to the distance of soils and subsoils associated with vehicle and plant movements across the Proposed Wind Farm site. This also has associated potential effects on the water environment; and therefore this aspect is assessed in further detail in Chapter 9 Water.

Pathway: Vehicle movement, surface water and wind action.

Receptor: Peat, subsoil and weathered bedrock.

Pre-Mitigation Potential Effect: Negative, slight, direct, permanent, likely effect on peat, subsoil and weathered bedrock due to felling operations at the Proposed Wind Farm site.

Proposed Mitigation Measures:

All proposed felling works will be completed in accordance with the best practice Forest Service regulation, policies and strategic guidance documents as well as Coillte and DAFM guidance documents to ensure that felling results in minimal potential negative effects on the local peat, soil and subsoil environment.

In addition, the following mitigation measures will be implemented during felling operations:

- Before any works are completed silt fences will be installed to limit the movement of entrained sediment in surface water runoff;
- The harvester and the forwarder are designed specifically for the forest environment and are low ground pressure machines;
- All machinery will be operated by suitably qualified personnel;
- These machines will traverse the Proposed Wind Farm site along specified off-road routes (referred to as racks);
- Brash mats will be placed on the racks to support the vehicles on soft ground, reducing peat and mineral soil disturbance and erosion and avoiding the formation of rutted areas, in which surface water ponding can occur;
- As felling progresses, the harvester will collect brash produced by the felling and place it in front of the machine before it advances forward along the rack;
- The condition of the racks will be continually monitored and fresh brash will be applied when the brash mat becomes heavily used and worm, ensuring that the mat remains effective throughout the operational phase; and,
- The location of racks will be chosen to avoid wet and potentially sensitive areas.

Post Mitigation Residual Effect: The proposed felling works will result in the disturbance and erosion of peat and subsoil within the Proposed Wind Farm site. However, given the minimal footprint of the proposed felling areas combined with the mitigation measures above, the residual effect is - negative, imperceptible, direct, permanent, unlikely effect on peat, subsoils and weathered bedrock.

Significance of Effects: For the reasons outlined above, and with the implementation of the proposed mitigation measures, no significant effects on peat, soils/subsoils or bedrock will occur.

8.6.2.7 Peat Instability and Failure

A Peat Stability Risk Assessment was carried out by AFRY for the main infrastructure elements at the Proposed Wind Farm site. This approach takes into account guidelines for geotechnical/peat stability risk assessments as given in PLHRAG (2017) and MacCulloch (2005). The Geotechnical and Peat Stability Assessment is attached in full as Appendix 8-1.

Peat instability or failure refers to a significant mass movement of a body of peat that would have an adverse impact on the proposed wind farm development and the surrounding environment. The potential significant effects of peat failure at the study area may result in:

- Death or injury to site personnel;
- Damage to machinery;
- Damage or loss of infrastructure;
- Drainage disruption by blockage of drainage pathway by relocated peat and spoil;
- Site works damaged or unstable;
- Contamination of watercourses, water supplies by particulates; and,
- Degradation of the peat environment by relocation of peat and spoil.

The findings of the peat assessment, which involved both a quantitative and qualitative analysis, showed that the Proposed Wind Farm site largely has an acceptable margin of safety and that the site is suitable for the Proposed Project. Only the access road to T05 was noted to have a 'medium' probability of peat failure based on the qualitative analysis. The management of peat stability and appropriate construction

practices will be inherent in the construction phase of the Proposed Project to ensure peat failures do not occur at the Proposed Wind Farm site.

Pathway: Vehicle movement and excavations.

Receptor: Peat and subsoils.

Pre-Mitigation Potential Effect: The findings of the Geotechnical and Peat Stability Assessment showed that the Proposed Wind Farm site has an acceptable margin of safety, is suitable for the Proposed Project and is considered to be at low risk of peat failure. The pre-mitigation residual effect is considered to be - Negative, significant, direct, permanent, likely effect on peat and subsoils.

Proposed Mitigation Measures:

Firstly, the key mitigation with regard peat stability risk at the Proposed Wind Farm site was the completion of a robust, multidisciplinary site investigation and peat stability risk assessment carried out in accordance with best practice guidance (PLHRAG, Scottish Government, 2017).

Also, the lessons learned from both peat slide events have been incorporated into the design of the Proposed Project and the construction methodologies to be implemented. These lessons show that it is important that the existing site drainage is maintained during construction to avoid a similar failure to that on Shass Mountain, which occurred following heavy rainfall, and this is referenced in the Risk Assessments for the turbines/access roads.

A key mitigation measures is the avoidance of areas which are assessed as having a high risk of failure. This scenario does not apply to the Proposed Project and there was no necessity for a revised planning layout.

The findings of the quantitative assessment showed that the Proposed Project areas have an acceptable margin of safety and that the site is suitable for the Proposed Project. Meanwhile, the qualitative assessment found that all areas, with the exception of the spur road to T5, have a low risk of peat failure. The spur road to T5 was found to have a medium probability of peat failure based on the peat depths and shear strength of the local peat deposits. With the implementation of the mitigation measures outlined below and in the Geotechnical and Peat Stability Assessment, the risk rating at all areas of the Proposed Wind Farm site is considered to be low (AFRY, 2024).

The management of peat stability and appropriate construction practices will be inherent in the construction phase of the Proposed Project to ensure peat failures do not occur.

The following control measures incorporated into the construction phase of the Proposed Project will ensure the management of the risks for this site:

- Appointment of experienced and competent contractors;
- The site will be supervised by experienced and qualified personnel;
- Allocate sufficient time for the Proposed Project (be aware that decreasing the construction time has the potential to increase the risk of initiating a localised peat movement);
- Prevent undercutting of slopes and unsupported excavations;
- Upslope cut-off drains will be installed in advance of construction activities to prevent water build up in excavations.
- The sides within excavated peat will be sloped back at an angle of 30 degrees to the horizontal to prevent slippage.
- No excavations shall take place unless fill material is available for filling at the point of excavation. Excavation will be limited to the reach of the excavator sitting on the constructed road surface.
- Any excavations will be immediately backfilled with suitable material when available.

- Excavation for access track to be backfilled as soon as practicable in intact peat. Excavation and filling operations will be co-ordinated to minimise the time an excavation remains unfilled.
- Deposition of excavated material must not occur outside designated areas; temporary stock piling would take place within the Proposed Project footprint of turbine hardstands before reinstatement and disposal at proposed peat and spoil repository areas.
- Temporary deposition of excavated soils will only be allowed in areas with peat depth less than 0.5m.
- Excavated spoil will not be deposited on the downslope or upslope edges of adjacent peat.
- Existing drainage patterns in peat will be maintained whenever possible, and any uncontrolled discharges of water onto peat will be prevented.
- Engineered drainage to prevent concentrated flow onto slopes or into excavations. Pumping to be used as required until a permanent solution is in place.
- As per *Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments* (Energy Consents Unit Scottish Government, 2017) catch wall fences shall be positioned downslope of the suspected or known landslide prone area to slow or halt runout. Similarly, catch ditches may also be used to slow or halt runout, although it is preferable that they are cut in non-peat material.
- Machinery use on peat surfaces would be minimized, and dependant on site topography the use of vibrating rollers may not be permitted.
- Materials must not be stockpiled, and heavy machinery must not be parked on peat surfaces.
- The use of low ground bearing pressure machines to be used on areas of peat exceeding 1m depth.
- No operatives other than the excavator driver to be allowed in close proximity to open excavations.
- Monitoring posts to be installed in vicinity of risk areas and to be inspected prior to and following works each day by a competent person.
- A qualified geotechnical and/or environmental engineer will conduct regular site visits and assessments to monitor the potential for a peat slide regularly during construction.
- Upon commencement of the reinstatement works, guidance from a suitably qualified environmental professional will be sought to confirm the methodology and programme.
- Exclusion zones delineating the working corridor will be established around all working areas using post and rope fences. No activity will be permitted past this fence.
- The environmental manager or other designated person will conduct induction training and toolbox talks with site staff to explain the risks associated with working on peat, the procedures for reducing the risk of peat slides, and the location of exclusion zones.
- Strict adherence to method statements is required at all times, and any deviation from the agreed work methodology must be approved by a suitably qualified environmental professional or the site geotechnical engineer.
- Particular attention will be paid to conditions during and after heavy rainstorms, especially following extended dry periods when the likelihood of peat movement is higher. The site supervisor would suspend work if either work practices or weather conditions are deemed unsafe.
- After reinstatement is completed, the peat and spoil repository areas will be re-vegetated using the topsoil, sod or harvested peat.

In relation to the spur road to T05 which was found to have a medium probability of peat instability in the qualitative assessment, the following addition mitigation measures have been proposed:

- Excavation side walls to be supported (e.g. boulders, sheet piles) or excavation face battered to a shallow angle;
- Temporary works designer may be required to provide excavation support design;
- Daily detailed inspection of excavation faces for signs of instability;
- Pumping will be used to remove any water inflow into the excavations; and,
- Provision of an increased exclusion zone around excavation to avoid accidental loading of crest of slope.

The above mitigation measures are proposed to reduce any existing risks to acceptable levels (AFRY, 2024).

Post Mitigation Residual Effect: A detailed Geotechnical and Peat Stability Assessment has been completed for the Proposed Project. The findings of that assessment have demonstrated that there is a low risk of peat failure at the Proposed Project site. With the implementation of the control measures outlined above the residual effect will be - Negative, imperceptible, direct, unlikely, permanent effect on peat and subsoils.

Significance of Effects: No significant effects on soils and subsoils will occur.

8.6.3 Operational Phase - Likely Significant Effects and Mitigation Measures

Very few potential direct impacts are envisaged during the operational phase of the Proposed Project. These may include:

- Some construction vehicles or plant may be necessary for maintenance of turbines which could result in minor accidental leaks or spills of fuel/oil;
- The transformer in the substation and transformers in each turbine are oil cooled. There is potential for spills / leaks of oils from this equipment resulting in contamination of soils and groundwater; and,
- In relation to indirect impacts a small amount of granular material may be required to maintain access tracks during operation which will place intermittent minor demand on local quarries.
- Emergency repair works to the Proposed Grid Connection Route electrical cabling which are highly unlikely.

8.6.3.1 Site Road Maintenance

In relation to indirect effects a small amount of granular material will be required to maintain access tracks/site roads during operation which will place intermittent minor demand on local quarries.

Pathway: Peat, subsoil and bedrock pore space.

Receptor: Peat, subsoil and bedrock.

Potential Pre-Mitigation Effect: Negative, indirect, imperceptible, short term, likely effect on peat, subsoil and bedrock.

Proposed Mitigation Measures:

- Use of aggregate from authorised quarries for use in road and hardstand maintenance.

Post Mitigation Residual Effect: The use of aggregate for site road maintenance will be minor and infrequent, and all material will be imported to the Proposed Project site from local authorised quarries.

The residual effect is considered to be - negative, imperceptible, indirect, short-term, unlikely effect on bedrock.

Significance of Effects: For the reasons outlined above, no significant effects on land, soils or geology will occur.

8.6.3.2 Site Vehicle/Plant Use

Plant and site vehicles used in site maintenance will be run on fuels and use hydraulic oils. Accidental spillage during refuelling of construction plant with petroleum hydrocarbons is a significant pollution risk to land, soils and associated ecosystems. The accumulation of small spills of fuels and lubricants during routine plant use can also be a pollution risk. Hydrocarbon has a high toxicity to humans, and all flora and fauna, and is persistent in the environment.

Pathway: Peat, subsoil and bedrock pore space.

Receptor: Peat, subsoil and bedrock.

Potential Pre-Mitigation Effect: Negative, direct, slight, short term, unlikely effect on peat, subsoil and bedrock.

Proposed Mitigation Measures:

- Vehicles used during the operational phase will be refuelled off site before entering the site;
- No fuels will be stored on-site during the operational phase; and
- Spill kits will be available in all site vehicles to deal with an accidental spillage and breakdowns; and,
- An emergency plan for the operational phase to deal with accidental spillages and breakdowns will be contained in the Construction and Environmental Management Plan (CEMP) included as Appendix 4-4.

Post-Mitigation Residual Effect: The use of hydrocarbons in plant and vehicles is a standard risk associated with all operational wind farm sites. Proven and effective measures to mitigate the risk of spills and leaks have been proposed above and will break the pathway between the potential source and the receptor. The residual effect is considered to be - negative, imperceptible, direct, short-term, unlikely effect on peat, subsoils, and bedrock.

Significance of Effects: For the reasons outlined above, no likely significant effects on land, soils, subsoils or bedrock will occur.

8.6.3.3 Use of Oils in Transformers

The transformer in the substation and transformers in each turbine are oil cooled. There is potential for spills / leaks of oils from this equipment resulting in contamination of soils and groundwater. Hydrocarbon has a high toxicity to humans, and all flora and fauna, and is persistent in the environment.

Pathway: Peat, subsoil and bedrock pore space.

Receptor: Peat, subsoil and bedrock.

Potential Pre-Mitigation Effect: Negative, direct, slight, short term, unlikely effect on peat, subsoil and bedrock.

Proposed Mitigation Measures:

- All transformers and substation areas will be bunded to 110% of the volume of oil used in each transformer/substation;
- An emergency plan for the operational phase to deal with accidental spillages will be contained in the CEMP included as Appendix 4-4.

Post-Mitigation Residual Effect: The use of hydrocarbons in transformers and substations is a standard risk associated with all operational wind farm sites. Proven and effective measures to mitigate the risk of spills and leaks have been proposed above and will break the pathway between the potential source and the receptor. The residual effect is considered to be - negative, imperceptible, direct, short-term, unlikely effect on peat, subsoils, and bedrock.

Significance of Effects: For the reasons outlined above, no likely significant effects on land, soils, subsoils or bedrock will occur.

8.6.4 Decommissioning Phase - Likely Significant Effects and Mitigation Measures

The potential effects associated with decommissioning of the Proposed Project will be similar to those associated with construction but of reduced magnitude.

During decommissioning, it will be possible to reverse or at least reduce some of the potential impacts caused during construction by rehabilitating construction areas such as turbine bases and hard standing areas. This will be done by covering the areas with peatland vegetation/scraw or poorly humified peat to encourage vegetation growth and reduce run-off and sedimentation. Other impacts such as possible soil contamination by fuel leaks will remain but will be of reduced magnitude. However, as noted in the Scottish Natural Heritage report (SNH) Research and Guidance on Restoration and Decommissioning of Onshore Wind Farms (SNH, 2013) reinstatement proposals for a wind farm are made approximately 30 years in advance, so within the lifespan of the Proposed Wind Farm, technological advances and preferred approaches to reinstatement are likely to change. According to the SNH guidance, it is therefore:

> *"best practice not to limit options too far in advance of actual decommissioning but to maintain informed flexibility until close to the end-of-life of the wind farm".*

Mitigation measures applied during decommissioning activities will be similar to those applied during construction where relevant.

Some of the effects will be avoided by leaving elements of the Proposed Project in place where appropriate. The 38kV electrical substation and Proposed Grid Connection Route cabling will be retained by ESB or EirGrid. The turbine bases will be rehabilitated by covering with local topsoil/peat in order to regenerate vegetation which will reduce runoff and sedimentation effects. Internal roads will remain as amenity pathways and forestry access roads. Mitigation measures to avoid contamination by accidental fuel leakage and compaction of soil by on-site plant will be implemented as per the construction phase mitigation measures.

No significant effects on the land, soils and geological environment will occur during the decommissioning stage of the Proposed Project.

8.6.5 Risk of Major Accidents and Disasters

Due to the nature of the Proposed Project site, i.e. sloping terrain with peat present, there is a slight risk of a landslide occurring.

A comprehensive Geotechnical and Peat Stability Risk Assessment (Appendix 8-1) has been undertaken for all Proposed Project infrastructure locations, and it concludes that with the implementation of the proposed control (mitigation) measures, the residual risk of a landslide occurring is determined to be negligible/none.

Please refer to Chapter 17 Major Accidents and Natural Disasters for a full assessment relating to the risk of landslides.

8.6.6 Human Health Effects

Potential health effects arise mainly through the potential for soil and ground contamination. The Proposed Project is not a recognized source of pollution (e.g. it's not a waste management site, or a chemical plant), and so the potential for effects during the operational phase is very low.

Hydrocarbons will be used onsite during construction; however, the volumes will be small in the context of the scale of the Proposed Project and will be handled and stored in accordance with best practice mitigation measures. The potential residual effects associated with soil or ground contamination and subsequent health effects are imperceptible.

8.6.7 Potential Cumulative Effects

Due to the localised nature of the proposed construction works which will be kept within the Proposed Project site, there is no potential for significant cumulative effects in-combination with other local developments on the land, soils and geology environment. The only way the wind farm proposal can have in combination effects with other off site projects and plans is via the drainage and off site surface water network, and this hydrological pathway is assessed in Chapter 9 Water.

The construction of the Proposed Grid Connection Route and works along the TDR will only require relatively localised excavation works within the site boundary and therefore will not contribute to any significant cumulative effects.

8.6.8 Post Construction Monitoring

None required.