

8. LAND SOILS AND GEOLOGY

8.1 Introduction

8.1.1 Background and Objectives

Hydro-Environmental Services (HES) was engaged by MKO to carry out an assessment of the potential likely and significant effects of a Proposed Wind Farm and Proposed Grid Connection (Proposed Project) at Cooloo and adjacent townlands in Co. Galway, on the Land, Soils and Geology aspects of the receiving environment.

The Proposed Project (Proposed Wind Farm and Proposed Grid Connection) is described in full in Chapter 4 of this EIAR.

Where the 'Proposed Wind Farm site' is referred to, this refers to the 9 no. turbines and associated foundations and hard-standing areas, turbine delivery route (TDR) accommodation works, access roads, temporary construction compound, underground cabling, peat and spoil repository areas, wind farm drainage, tree felling, biodiversity enhancement area and all ancillary works.

The "Proposed Grid Connection" relates to the ~21km underground 110kV cabling route, on-site 110kV substation, proposed access road, battery energy storage system (BESS) and all associated infrastructure.

Where 'the Site' is referred to, this relates to the primary study area for the Proposed Project EIAR, as delineated by the EIAR Site Boundary and includes both the Proposed Wind Farm site and Proposed Grid Connection.

This report 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 and 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.

The Proposed Project Study Area with regard Land, Soils and Geology is within a 2km distance the EIAR Site Boundary. However, only direct effects within the EIAR Site Boundary are expected with regard the Proposed Project.

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 our office is located in Dungarvan, County Waterford.

Our core areas of expertise and experience include soils, subsoils and geology. We 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 David Broderick.

Michael Gill (P. Geo., B.A.I., MSc, Dip. Geol., MIEI) is an Environmental Engineer/Hydrologist with over 24 years' environmental consultancy experience in Ireland. Michael has completed numerous

hydrological and hydrogeological impact assessments of wind farms in Ireland. He has also managed EIA assessments for infrastructure projects and private residential and commercial developments. In addition, he has substantial experience in wastewater engineering and site suitability assessments, contaminated land investigation and assessment, wetland hydrology/hydrogeology, water resource assessments, surface water drainage design and SUDs design, and surface water/groundwater interactions. For example, Michael has worked on the EIS/EIAs for Seven Hills Wind Farm, Lackareagh Wind Farm, and Carrownagowan Wind Farm, and over 100 other wind farm related projects across the country.

David Broderick (P. Geo., BSc, H. Dip Env Eng, MSc) is a Hydrogeologist with over 19 years' experience in both the public and private sectors. Having spent two years working in the Geological Survey of Ireland working mainly on groundwater and source protection studies David moved into the private sector. David has a strong background in groundwater resource assessment and hydrogeological/hydrological investigations in relation to developments such as quarries and wind farms. David has completed numerous geology and water sections for input into EIAs for a range of commercial developments. David has worked on the EIS/EIAs for Clonberne Wind Farm, Knockalough Wind Farm, and Arderroo Wind Farm, and over 60 other wind farm related projects across the country.

8.1.3 Relevant Legislation

The EIA 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, 2000-2021;
- 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;
- S.I. No. 296/2018 European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018; and,
- The Heritage Act 1995, as amended.

8.1.4 Relevant Guidance

The Land, Soils and Geology chapter of this EIA 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 (2009): 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 Site and Study Area was completed in advance of undertaking the walkover survey and site investigations. This involved collecting all relevant geological data for the Site and receiving environment. This 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 14 (Geology of Galway Bay). Geological Survey of Ireland (GSI, 2004);
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 12 (Geology of Longford/Roscommon). Geological Survey of Ireland (GSI, 2003);
- Geological Survey of Ireland (2003) – Clare-Corrib Groundwater Body Initial Characterization Reports;
- General Soil Map of Ireland 2nd edition (www.epa.ie); and,
- Aerial Photography, OSI 1:5000 and 6 inch base mapping.

8.2.2 Baseline Monitoring and Site Investigations

A walkover survey, including geological mapping and investigations of the Site, were undertaken by David Broderick of HES (refer to Section 8.1.2 above for qualifications and experience) on 15th August and 24th October 2022, 23rd and 28th March 2023, 20th and 21st August 2024, 22nd May, 8th July and 3rd September 2025.

The following reports were prepared by Gavin and Doherty Geosolutions (GDG) in support of the application:

- Peat Stability Risk Assessment (**Appendix 8-1**)
- Geotechnical Karst Risk Assessment (**Appendix 8-2**)
- Grid Connection Ground Conditions Assessment (**Appendix 8-3**)
- Peat and Spoil Management Plan (**Appendix 4-2**)

As part of the Geotechnical Karst Risk Assessment a geophysical survey was carried out by Minerex Geophysics Ltd on 26th August 2025 (the geophysical survey report is included in GDG Geotechnical Karst Risk Assessment report).

The objectives of the intrusive site investigations and geophysical surveys (described further below) included mapping the distribution and depth of peat and mineral subsoils at the Site along with assessing the mineral subsoil / bedrock conditions at key Proposed Project locations (i.e. proposed turbines, temporary construction compound, existing and proposed access roads, peat and spoil repository areas, grid cable and substation). This data was used to inform the impact assessment and final layout design.

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

- Walkover surveys and geological mapping of the Site area were undertaken to assess general ground conditions;
- A total of 306 no. peat probes were undertaken by HES, MKO and GDG to determine the thickness and geomorphology of peat overlying parts of the Site;
- Trial pitting (26 no.) by GDG and gouge cores (10 no.) by HES to investigate soil, peat and mineral subsoil lithology as well as depth to bedrock;
- Field based karst feature mapping by GDG and follow-up surveys by HES;
- Investigation drilling (2 no. boreholes under supervision of HES) to determine the full geological profile of the Site (i.e. peat, mineral subsoil and bedrock profile) and groundwater conditions;
- 2D Resistivity (ERT) survey (4 no. lines) and Seismic survey (1 no. location) by Minerex Geophysics Ltd;
- Subsoil analysis (25 no. Atterberg limit tests, 28 no. moisture content test and 26 no. particle size distribution tests);
- 1 no. rotary core borehole (GSI-17-003), where the log is available from the GSI online borehole database, was previously drilled within the Site; and,
- Mineral subsoils and peat were logged according to BS: 5930 and Von Post Scale respectively.

8.2.3 Scope and Consultation

The scope for this chapter of the EIAR has also been informed by consultation with statutory consultees, bodies with environmental responsibility and other interested parties. This consultation process and the list of Consultees is outlined in Section 2.5 of this EIAR.

Matters raised by Consultees in their responses with respect to the land/soil environment are summarised in

Table 8-1 below.

Table 8-1 Summary Scoping Responses

Consultee	Matters Raised - Description	Addressed in Sections
Geological Survey of Ireland (GSI)	<i>“Our records show that there is a County Geological Site (CGS) adjacent to the proposed wind farm development study area. Derrynagran Bog and Esker, Co Galway (GR 157903, 252148), under IGH themes: IGH7 Quaternary, IGH16 Hydrogeology”.</i> <i>“While it is recognised that the wind energy developments are an important place in the development of Ireland’s renewable energy industry, any future wind-farm development and associated infrastructure including drainage, transmission and access road construction in the surrounding area may pose a threat to the integrity of the site. This site should be assessed as an environmental constraint. Ideally, the site should not be damaged or integrity impacted or reduced in any manner due to any proposed construction and/or modification of access roads, from traffic due to access road construction, turbine and hard stand installation”.</i>	Refer to Sections 8.3.4, 8.3.4, 8.3.6, 8.3.11 & 8.5.2.6 Appendix 8-2: Geotechnical Karst Risk Assessment

Consultee	Matters Raised - Description	Addressed in Sections
	<i>“Our Viewer indicates there are numerous karst landforms including enclosed depressions within the proposed wind farm development study area”.</i>	
Department of Housing, Local Government and Heritage	<i>“Peat stability should be assessed where required”.</i>	Refer to Section 8.5.2.5 Appendix 8-1: Peat Stability Risk Assessment, Appendix 8-3: Grid Connection Ground Conditions Assessment
HSE	<i>“A detailed assessment of the current ground stability of the site for the proposed renewable energy development and all proposed mitigation measures should be detailed in the EIAR. The assessment should include the impact construction work may have on the future stability of ground conditions, taking into consideration extreme weather events, site drainage and the potential for soil erosion”.</i>	Refer to Sections 8.5.2.2, 8.5.2.5 and 8.5.2.6. Appendix 8-1: Peat Stability Risk Assessment, Appendix 8-2: Geotechnical Karst Risk Assessment & Appendix 8-3: Grid Connection Ground Conditions

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 EIAR Site Boundary is assessed using the criteria set out in **Table 8-2** (NRA, 2009).

Table 8-2 Estimation of Importance of Soil and Geology Criteria (NRA, 2009).

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 route is significant on a national or regional scale.	Geological feature rare on a regional or national scale (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 fertility soils. Moderately sized existing quarry or pit Marginally economic extractable mineral resource.

Importance	Criteria	Typical Example
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 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.	Large historical and/or recent site for construction and demolition wastes. Small historical and/or recent landfill site for construction and demolition wastes. Poorly drained and/or low fertility soils. Uneconomically extractable mineral Resource.

The guideline criteria (EPA, 2022) for the assessment of likely significant effects require that likely effects are described with respect to their extent, magnitude, type (i.e. negative, positive or neutral) probability, duration, frequency, reversibility, and transfrontier nature (if applicable).

The descriptors used in this environmental impact assessment report are those set out in the EPA (2022) Glossary of effects as shown in Chapter 1 of this EIAR. In addition, the two impact characteristics proximity and probability are described for each impact and these are defined in

.

Table 8-3.

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 8-4.

Table 8-3: Additional Impact Characteristics.

Impact Characteristic	Degree/Nature	Description
Proximity	Direct	An impact which occurs within the area of the proposed project, as a direct result of the proposed project.
	Indirect	An impact which is caused by the interaction of effects, or by off-site developments.
Probability	Unlikely	A low likelihood of occurrence of the impact.
	Likely	A medium likelihood of occurrence of the impact.

Table 8-4: 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 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 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: ➤ 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 Limitations and Difficulties Encountered

No limitations or difficulties were encountered during the preparation of the Land, Soils and Geology Chapter of this EIAR. The site investigations and follow up monitoring carried out were thorough.

8.3 Existing Environment

8.3.1

Site Description and Topography

The Site, which is 376.5ha (hectares) in area, comprises areas of intact raised bog, cutover raised bog, forestry, agricultural grassland and scrubland. The Site is located approximately 2.5km to the east of Barnaderg Village, Co. Galway.

The current land use at the Site, mapped by Corine landcover mapping, is dominated by agricultural pastureland (approximately 86%) with peat bogs (approximately 11%) and transitional woodland scrub (approximately 3%).

The majority of the northern portion of the Proposed Wind Farm site is bog while the southern portion is mainly grassland pastures. It's likely a large proportion of the grassland pastures were also originally bog prior to been drained and improved for agricultural use. An isolated area of forestry is located centrally within the Proposed Wind Farm site. Peat cutting in the form of private turbary plots is widespread around the edges the bogs. There are also several separate farmsteads within the Proposed Wind Farm site.

The topography of the Proposed Wind Farm site is undulating with gentle slopes typical of a low-lying raised bog setting with surrounding local hills. The elevation of the Proposed Wind Farm site ranges from approximately 65m OD (metres above Ordnance Datum) to 80m OD, with slopes falling to the north and southeast from a high point located centrally with the Proposed Wind Farm site which also coincides with a surface water catchment topographic divide between the Grange River to the north and the Abbert River to the south.

The lower (ground elevations) parts of the Proposed Wind Farm site are in the west and the north and this is also where most of the bog coverage is. The higher elevated part of the Proposed Wind farm site centrally is mainly undulating grassland.

The Proposed Wind Farm site is drained by several 1st order watercourses that emerge from the peatland areas. There is also a high density of man-made drainage associated with both the peatland and grassland areas. The man-made drainage density is evident on the OSI 6", 25" mapping and aerial imagery. The indicates significant efforts to drain and reclaim the former peat bog land as well as improve adjacent grassland.

The Proposed Wind Farm site is currently accessible via a network of local public roads and private, bog and farms tracks. The proposed entrance to the Proposed Wind Farm site and Proposed Grid Connection 110kV substation is off the R332 which runs to the southwest of the Proposed Wind Farm site. Approximately 1.2km of existing tracks will be upgraded as part of the Proposed Project. The northern portion of the Site is also accessible by a network of public roads.

With regard the main elements of the Proposed Wind Farm site infrastructure, proposed turbine locations T1, T3, T4, T6, T7 and T8 are located on grassland, while turbines T2, T5 and T9 are located on cutover raised bog.

The proposed temporary construction compound, located in the southwest of the Proposed Wind Farm site, is in grassland. The proposed 4 no. peat repositories areas and 5 no. spoil repository areas are located on both grassland and bog.

Proposed Wind Farm access roads are mainly on grasslands, but cutover bog and an approximately 0.5km section of intact raised bog will be crossed by the proposed access road to turbine T7.

The Proposed Grid Connection 110kV underground cabling route, which measures approximately 21km in length, will connect into the existing Cloon 110kV substation near Tuam town, located approximately 10km to the west of the Proposed Wind Farm site. The proposed 110kV on-site substation is located on improved grassland in the southwest of the Proposed Wind Farm site.

On leaving the onsite substation location at the Proposed Wind Farm site, the cabling route initially follows a farm track for approximately 1km, followed by Proposed Wind Farm site access roads, which is currently grassland, for approximately 1.5km before exiting the Proposed Wind Farm site on the R332. The Proposed Grid Connection cabling route then follows public roads for the remainder of the distance to the Cloon 110kV substation.

Turbine Delivery Route (TDR) accommodation works are required on the N63/R332 junction where a temporary road will be required just south of Horesleap Lough. There is also an overrun area on the R332 at the proposed Site entrance.

8.3.2 Soils and Subsoils

8.3.2.1 GSI Mapping

Based on the Teagasc soils mapping (www.gsi.ie), the Proposed Wind Farm site is predominantly covered by cutaway/cutover peat, peaty poorly drained mineral soil (BminPDPT), deep well drained mineral soil (BminDW) along with some localised deep poorly drained mineral soil (BminPD). Geomorphologically, the peat at the Site is raised bog, also known as basin peat.

The majority of the grassland areas surrounding the bog on the north and centrally within the Site are mapped to have BminPDPT and BminPD soil. BminDW soils are limited to grassland areas on the far south of the Proposed Wind Farm site.

The GSI subsoils map (www.gsi.ie) also shows that the Proposed Wind Farm site has a dominant coverage of cutover raised peat (50%) which in turn is surrounded by limestone tills (47%) with the remaining 3% mapped as alluvium, bedrock subcrop and water. The GSI mapped cutover bogs areas also includes areas of grasslands which suggests these grassland areas are improved/reclaimed.

Based on the GSI subsoils mapping, proposed turbine locations T1, T3, T4, T6, T7 and T8 are located on limestone tills, while T2, T5 and T9 on cutover raised peat. All proposed 4 no. peat repositories are also located on cutover raised peat.

With regard the Proposed Grid Connection, the proposed Substation is mapped to be underlain by limestone tills including the section of Proposed Grid Connection within the Proposed Wind Farm site.

Based on the GSI mapping, limestone tills are dominant along the Proposed Grid Connection outside the Proposed Wind Farm site. This is followed by areas of cut over raised peat, with smaller areas of gravels derived from limestone, alluvium, and minor patches of eskers, lacustrine sediments, and karstified bedrock outcrop/subcrop. Refer to the Grid Connection Ground Conditions Assessment carried out by GDG (**Appendix 8-3**) for further details.

TDR accommodation works required on the N63/R332 junction and overrun area on the R332 at the proposed Site entrance are mapped on limestone tills.

The GSI subsoils maps is shown as **Figure 8-1** below.



8.3.2.2 Peat Depth Probing

A total of 306 no. peat probes were carried out at the Site. Peat depths were also determined from the 10 no. gouge cores, 26 no. trial pits and 2 no. investigation boreholes (gouge cores, trial pitting and investigation drilling are discussed in detail further below).

27 no. of these investigation locations included the Proposed Grid Connection. These included 1 no. borehole (BH1), 23 no. peat probes, and 3 no. trial pits.

The peat thickness encountered by intrusive investigations across the Proposed Wind Farm site varies from 0m (in areas where peat is absent) to a maximum of 7.1m, with an average of 1.3m, and a median of 0.4m recorded.

Areas of the Proposed Wind Farm site containing little to no peat, underlain by cohesive or granular glacial tills, include turbines T1, T4, T6 to T8, the substation, construction compound and the southern and central Proposed Wind Farm site access tracks.

Much of the remaining proposed infrastructure, including turbines T2, T3, T5 & T7 hardstands and turbine T9, the BESS compound and the majority of the northern access tracks, are in areas of cut-over peat, where turbary peat harvesting has removed significant quantities of peat, reducing peat thicknesses.

The peat depth distribution range is shown in **Figure 8-2** below. In total, 53% of recorded peat depths were under 0.5m, 64% were under 1m, and 74% were under 2m. A summary peat depth map is shown as **Figure 8-3** below.

Laterally extensive regions of >3m in depth (of peat) were encountered in raised bog settings, particularly to the north of turbine T5 (approx. 30m), to the southeast of turbine T7 (approx. 120m from the hardstand), to the west of turbine T9 (approx. 200m) and the north of turbine T2 (approx. 100m).

These areas of deep peat are restricted to discrete raised bogs, which all major infrastructure positioning has avoided, aside from the proposed floated track between T7 and T9, which passes across one area of raised bog, with recorded peat depths of up to 6.8m.

Along the Proposed Grid Connection peat was only encountered at 4 no. of the 27 no. investigation locations where depths ranged from 0.2 to 2m. Peat depths along the public road section of the grid cable route were not investigated.

Summary peat depth at the Proposed Project key infrastructure locations is shown on **Table 8-6** below.

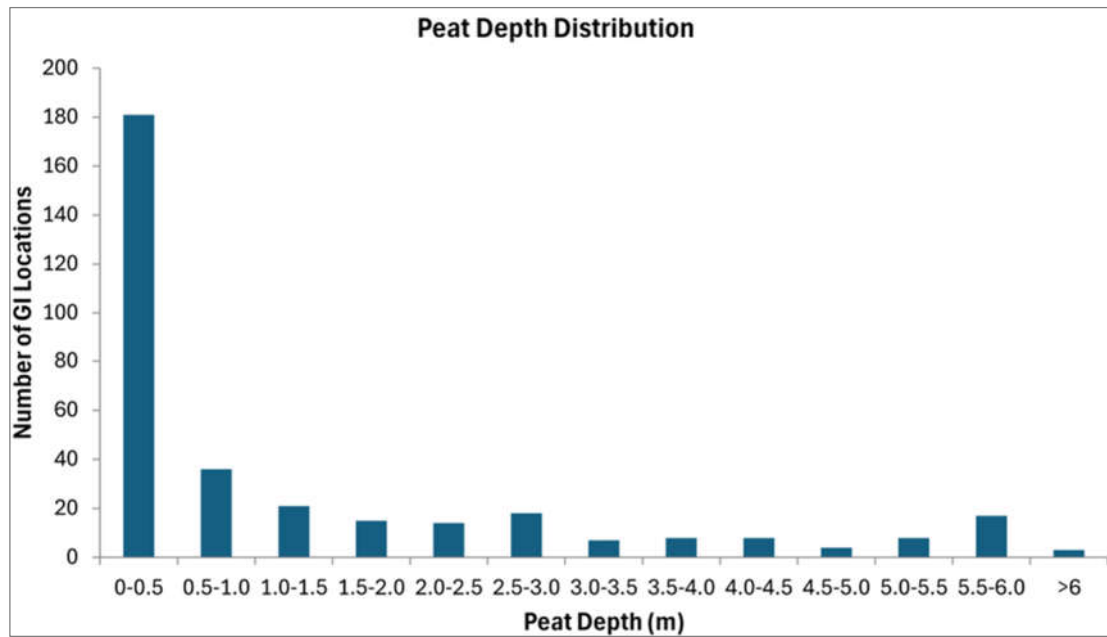


Figure 8-2 Peat Thickness Distribution (GDG, 2025)

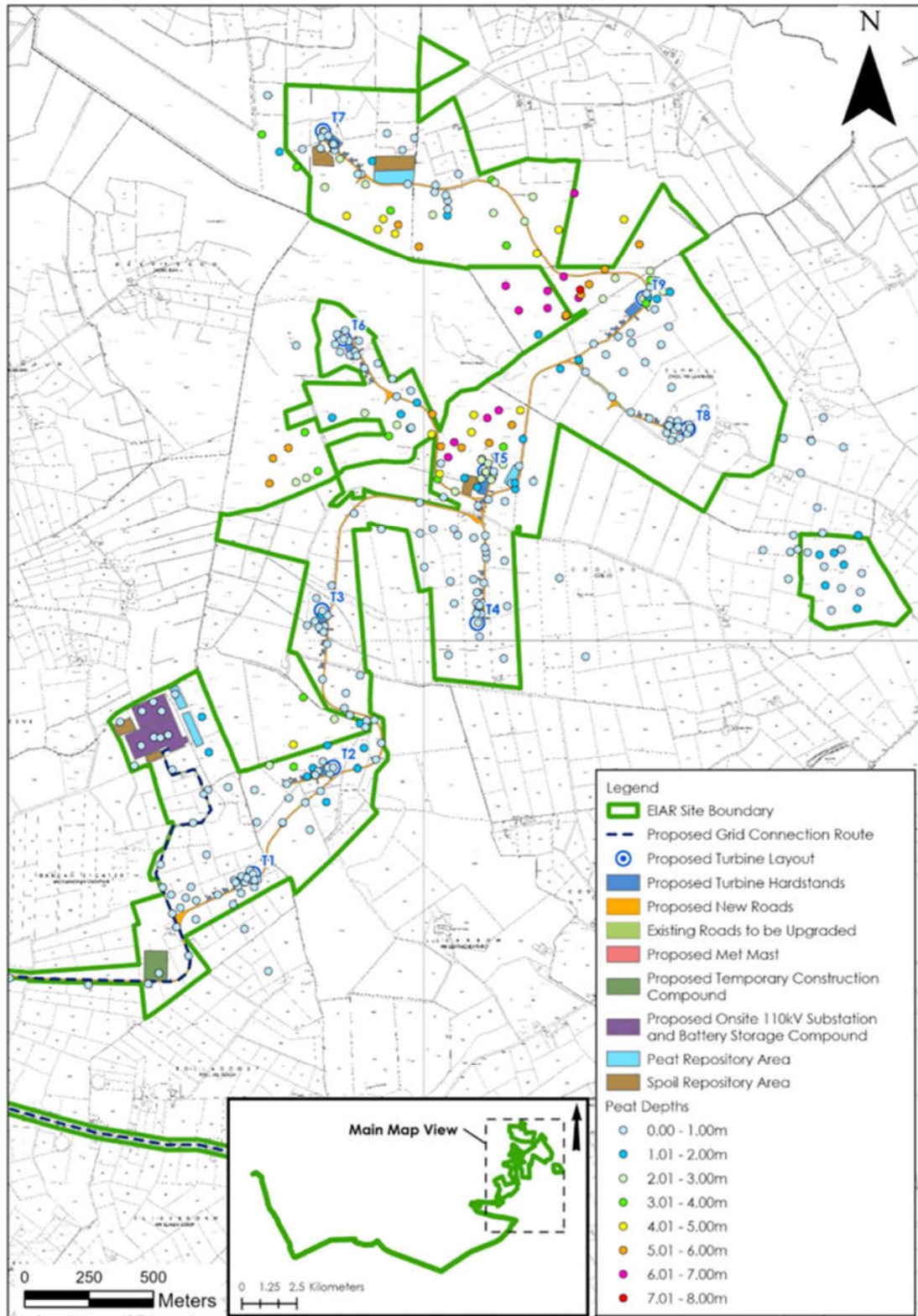


Figure 8-3 Summary Peat Depth Map

8.3.2.3 Site Investigations (GSI Database)

One rotary core borehole (GSI-17-003) from the GSI online borehole database was previously drilled within the Proposed Wind Farm site in 2016, approximately 390m east of turbine location T7. The available borehole log indicated that bedrock was encountered at 5m below ground level (mbgl) and was drilled to a final depth of 122mbgl. No description of the overburden type was provided in the log. Refer to Section 8.3.3.4 for details on bedrock lithology.

Refer to **Figure 8-4** below for the location of borehole (GSI-17-003). The GSI borehole log is attached as **Appendix 8-4**.

8.3.2.4 Site Investigations (Drilling and Trial Pitting)

Extensive ground investigations were carried out between 2022 and 2025 to determine the geological and hydrogeological setting of the Site.

Trial pit investigations were carried out in 2022 (11 no.) and in 2025 (15 no.) by GDG. The drilling investigations in particular were focused in the area where the Mid Galway Public Water Supply (PWS) Source Protection Area overlaps with the Proposed Wind Farm site (refer to Chapter 9 – Water for details).

The ground conditions are generally variable across the Proposed Wind Farm site, and comprise PEAT, Lacustrine Marl (CLAY/SILT), Cohesive Glacial Till (CLAY/SILT) and Granular Glacial Till (SAND/GRAVEL) layers overlying limestone bedrock. Refer to

Table 8-5 for a summary of overburden conditions at the Site.

Soft lacustrine marls are encountered underlying the peat in some locations (particularly evident in the vicinity of T9). Topsoil has been encountered across the Proposed Wind Farm site in varying thicknesses.

Depth to bedrock was confirmed in 14 no. of the 26 no. trial pits. Depth to bedrock ranged from 0.8m to 3.6m with an average of 2.2m.

BH1 and BH2 were drilled on the south of the Proposed Wind Farm site. BH1, located 350m to the southwest of turbine T1 encountered 4.9m of glacial tills (gravelly CLAY) over limestone bedrock. BH2, located 250m to the northeast of turbine T2, encountered 2.6m of SAND and GRAVEL over limestone bedrock.

Depth to bedrock was confirmed at 7 no. of the proposed 9 no. turbines (T1, T2, T3, T4, T5, T6 & T8), where the depth ranged from 0.95m (turbine T1) to 3.6m (turbine T5).

Trial pit logs are attached to the Peat Stability Risk Assessment Report (**Appendix 8-1**). Drilling logs for BH1 and BH2 are attached as **Appendix 8-4**. Refer to **Figure 8-4** for the locations of trial pits and boreholes.

A summary of the site investigations finding at key development locations at the Site are shown below in **Table 8-6**.

Table 8-5: Summary of General Overburden Conditions (GDG, 2025)

Strata	Typical Description	Thickness (m)			Depth to top (m BGL)
		Min.	Max.	Median	
Peat		0	7.1	0.4	0
Lacustrine Marl (CLAY/SILT)	Very soft, greyish white sandy CLAY/SILT.	0	2.7	0.7	0.3 – 3.3
Cohesive Glacial Till (CLAY/SILT)	Soft to very stiff, greyish brown, slightly sandy, slightly gravelly CLAY with low to medium cobble and boulder content.	0	Not proven	Not proven	0.1 – 1.1
Granular Glacial Till (SAND / GRAVEL)	Sandy GRAVEL with high cobble and boulder content.	0	2.5	0.4-1.95	0.0 – 4.9

Table 8-6: Summary of Peat Depths and Mineral Subsoil Lithology at Proposed Project Locations

Location ID	Site Investigation ID	Probe Average Peat Depth (m)	Total Depth to Bedrock (mbgl)	Summary of Mineral Subsoil Lithology
PROPOSED WIND FARM SITE				
T1	BH1 & TP04	0	0.95	Gravelly CLAY over gravelly SILT
T2	BH2, TP03 & TPT2	0.5	2.0	Silty, sandy GRAVEL
T3	TP02 & TPT3	0.9	2.5	Gravelly CLAY over gravelly SILT
T4	TP01 & TPT4	0	2.75	Gravelly SILT over gravelly CLAY
T5	TP06 & TPT5	1.6	3.6	Sandy SILT (possibly Marl)
T6	TP08 & TPT6	0	2.7	Gravelly CLAY
T7	GC-TP7	0	>0.2	Gravelly CLAY
T8	TP10 & TPT8	0	2.7	Gravelly SILT
T9	TP07 & TPT9	2.3	>3.5	Sandy CLAY (possibly Marl)
Construction Compound	TP09	0	1.8	Gravelly CLAY
PROPOSED GRID CONNECTION				
Substation /BESS	TP05	0.1	0.8	Gravelly SILT over GRAVEL
GC Cable	BH01, TP05, TP14 and TP09	0.8	0.8 – 4.9	Gravelly CLAY/gravelly SILT

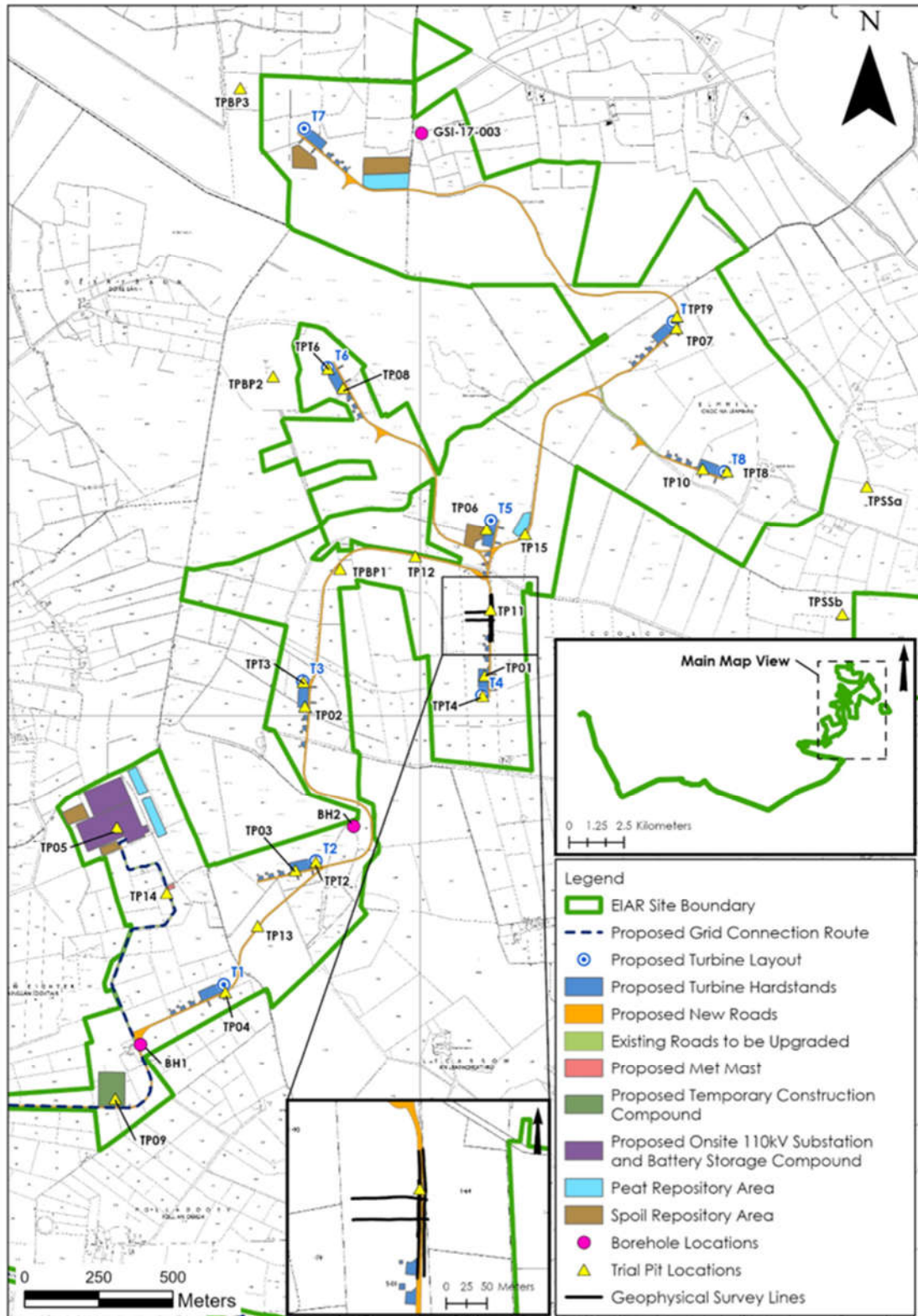


Figure 8-4 Site Investigation Map

8.3.3 Bedrock Geology

8.3.3.1 GSI Mapping

According to the GSI bedrock geological map of Ireland at 1:100,000 scale (GSI, 2025), the bedrock underlying the Proposed Wind Farm site consists of limestone of the Burren Formation, undifferentiated Viséan limestones and the Croghan Limestone formation. A bedrock geology map is shown as **Figure 8-6** below.

The most northern part of the Proposed Wind Farm site, approximately 100m northeast of T7, is mapped as the Croghan Formation, while most of the remainder of the Site is mapped as Undifferentiated Viséan Limestones, aside from a small band of Burren Formation rocks, mapped at T7, and running south-east from this location to approximately 150m north of T9. All of the turbine locations, except T7, are mapped as being underlain by Undifferentiated Viséan Limestones.

Pale grey, clean skeletal limestone typifies the Burren Formation, while the Croghan formation comprises dark cherty limestones and shales.

Little information is available regarding the Undifferentiated Viséan Limestones; however, they are anticipated to consist of pure, bedded limestone according to the GSI. However, BH1 and BH2 were drilled on the south of the Proposed Wind Farm site which is mapped to be underlain by Undifferentiated Viséan Limestones. The bedrock encountered here had similar lithology to the Croghan Limestone formation (i.e. dark limestone with impurities). This is discussed further in Section 8.3.3.4 below.

The bedrock underlying the Proposed Grid Connection is mapped as undifferentiated Viséan Limestone and the Burren Formation.

8.3.3.2 Previous Site Investigations

One rotary core borehole (GSI-17-003) from the GSI borehole database was drilled within the Proposed Wind Farm site in 2016, approximately 390m east of turbine T7. The available borehole log indicated that bedrock was encountered at 5mbgl and was drilled to a final depth of 122mbgl.

A dark grey argillaceous LIMESTONE and calcareous MUDSTONE from the Croghan Formation was encountered from 5 to 105m below ground level (mbgl). A very fine-grained argillaceous LIMESTONE of the Ballymore Formation was encountered from 105 to 122mbgl.

Refer to **Figure 8-4** for the GSI borehole location. The GSI borehole log is attached as **Appendix 8-4** and is summarised in **Table 8-7** below.

Table 8-7: Summary Log of GSI Borehole GSI-17-003

BH ID	Depth Range (m bgl)	Summary Description
GSI-17-003	5 to 44	Dark grey argillaceous bioclastic LIMESTONE and calcareous MUDSTONE
	44 to 105	Dark grey argillaceous bioclastic LIMESTONE with alternating calcareous MUDSTONE
	105 to 122	Very fined grained argillaceous LIMESTONE with calcareous MUDSTONE

8.3.3.3 Trial Pitting

Bedrock was confirmed in 14 no. of the 26 no. trial pits. Depth to bedrock ranged from 0.8m to 3.6m with an average of 2.2m. Grey to dark grey LIMESTONE was encountered at all locations.

10 no. of the trial pits encountered competent, unweathered, grey, massive LIMESTONE. While weathered and/or fractured LIMESTONE was only encountered in 4 no. trial pits. No epi-karst¹ weathering was encountered in any of the trial pits. A summary of bedrock conditions encountered at key Proposed Project locations is shown in **Table 8-8** below.

Competent, massive LIMESTONE was encountered at the majority (70%) of the Proposed Project locations.

Table 8-8: Bedrock Description Encountered During Trial Pitting

Location	Overburden Depth (m)	Trial Pit Bedrock Description
T1	0.95	Weathered LIMESTONE
T2	2	Grey massive LIMESTONE
T3	2.5	Grey massive LIMESTONE
T4	2.75	Dark grey massive LIMESTONE
T5	3.6	Dark grey massive LIMESTONE
T6	2.7	Possible weathered LIMESTONE
T7	Unknown	Bedrock not confirmed
T8	2.7	Grey massive LIMESTONE
T9	>3.5	Bedrock not confirmed
Construction Comp	1.8	Grey massive LIMESTONE
Substation /BESS	0.8	Grey massive LIMESTONE

8.3.3.4 Investigation Drilling

As part of the EIAR investigations, BH1 and BH2 were drilled in August 2022 on the south of the Proposed Wind Farm site where the GSI mapped geology is Undifferentiated Viséan Limestones. Borehole logs are attached as **Appendix 8-4** and are summarised in **Table 8-9** below.

BH1 was drilled to a depth of 20m and encountered weak dark grey LIMESTONE with MUDSTONE layers between 4.9 and 7mbgl. Strong dark grey LIMESTONE was encountered between 7 and 20mbgl (with some fracturing between 14.5 and 15mbgl).

BH2 encountered strong to very strong dark grey LIMESTONE with occasional MUDSTONE layers throughout the full depth of borehole (2.6 to 20mbgl).

¹ The epikarst, which consists of highly weathered rock in the upper vadose zone of exposed karst systems, plays a critical role in determining the hydrologic and geochemical characteristics of recharge to an underlying karst aquifer.

No epikarst layer, karst conduits, significant fractures or clay infilled fractures were encountered which would be typical characteristics of karstified limestone (see Section 8.3.4 below).

What's notable about the known bedrock geology of the Proposed Wind Farm site is that all investigation drilling data available to date (i.e. BH1, BH2 and GSI-17-003) encountered impure argillaceous LIMESTONE (i.e. clay impurities) with MUDSTONE layers. Impure, argillaceous limestone is typically less prone to karstification. MUDSTONE is not prone to karstification.

The presence of impure LIMESTONE and MUDSTONE bedrock sequencing underlying the north (at BH GSI-17-003) and south (at BH1 and BH2) of the Proposed Wind Farm site would suggest the mapped Undifferentiated Viséan Limestones encountered on the south of the Proposed Wind Farm site have a similar lithology to the Croghan Formation encountered at GSI-17-003 borehole on the far north of the Proposed Wind Farm site.

This suggests a bedrock type similar to the Croghan Formation extends further south into the southern portion Proposed Wind Farm site.

Table 8-9: Investigation Drilling Summary Logs

BH ID	Depth Range (m bgl)	Summary Description
BH1	4.9 to 7	Weak, dark grey LIMESTONE with MUDSTONE layers
	7 to 20	Strong, dark grey LIMESTONE
BH2	2.6 to 20	Strong to very strong dark grey LIMESTONE with occasional MUDSTONE layers

8.3.3.5 Geophysical Survey

A geophysical surveying including 2D Resistivity (4 no. lines) and Seismic (1 no. line) was carried out in the area of proposed turbine T4 and its access road which has an alignment to the north of the turbine location.

Refer to **Figure 8-4** and **Figure 8-8** for the geophysical survey locations. The geophysical survey report is attached to the Geotechnical Karst Risk Assessment report (**Appendix 8-2**).

The geophysical survey was targeted in this area to assess the potential for karstification as a number of shallow enclosed depression features (potential karst feature as described further in Section 8.3.4 below) are present locally.

In, addition there are several GSI karst features mapped to the southeast of the Proposed Wind Farm site at this location, as also described below.

All 4 no. 2D Resistivity survey lines encountered competent, fresh unweathered LIMESTONE bedrock. No epikarst layer or deeper karstification was found to be present at the survey locations. Refer to

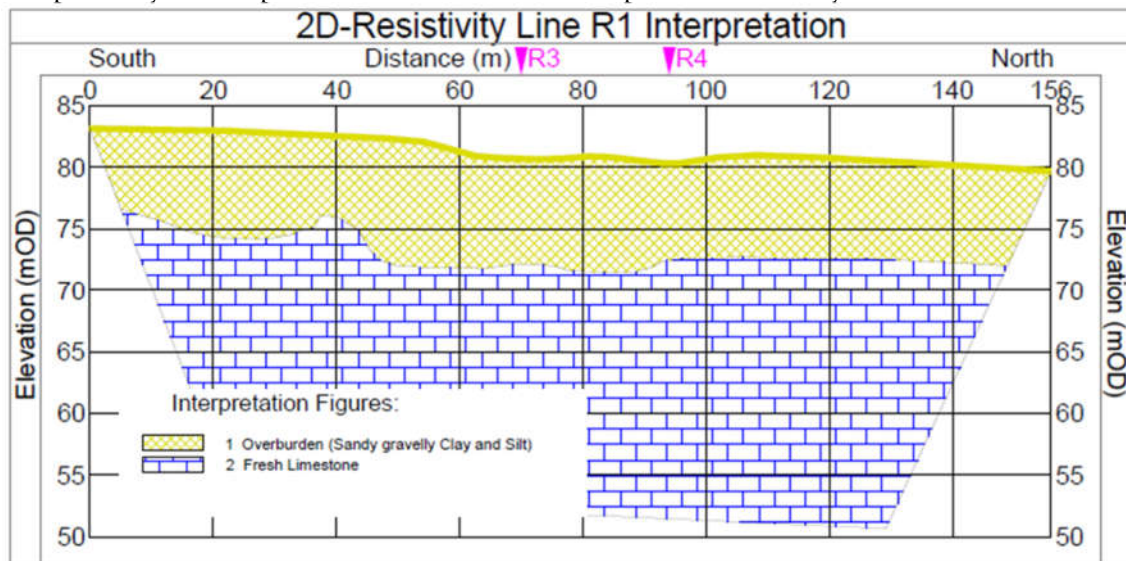
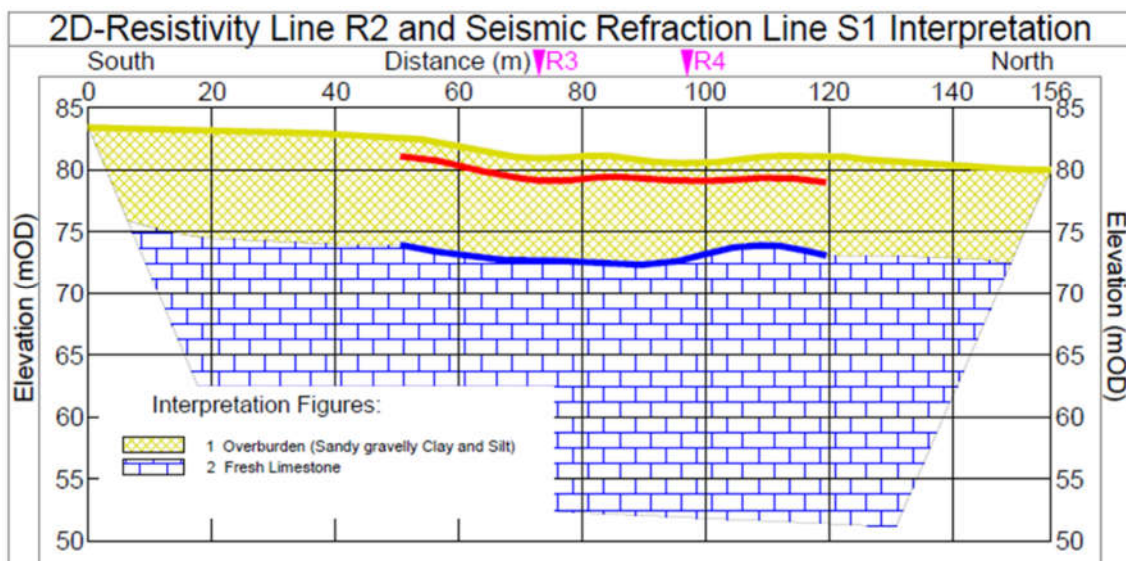


Figure 8-5 below for typical bedrock interpretation near turbine T4.

The total length combined length of the 4 no. 2D Resistivity survey lines is 500m, and no evidence of karstification was identified over this distance.



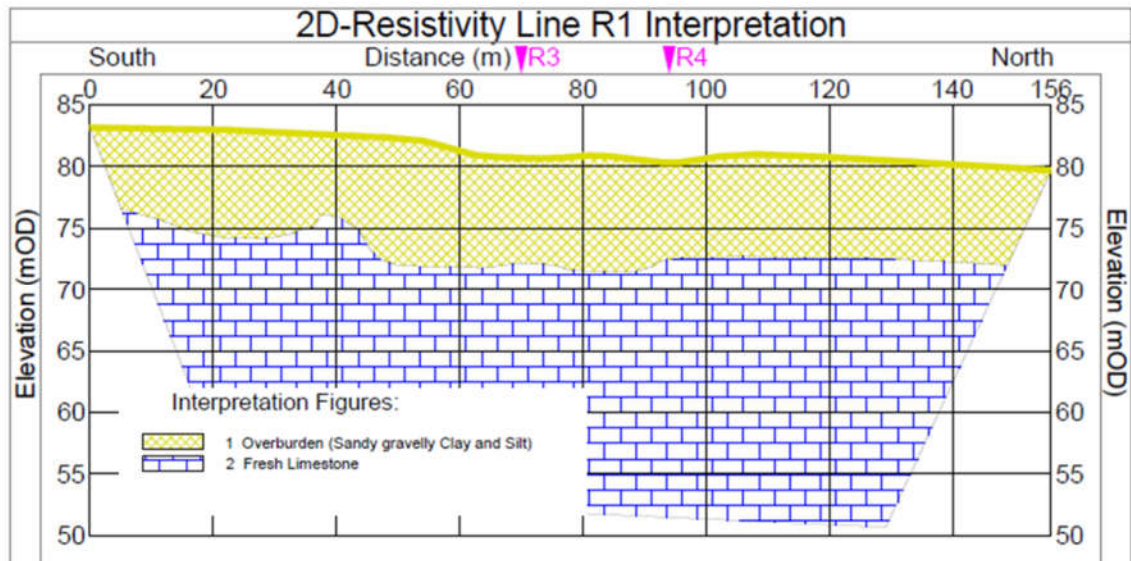


Figure 8-5 Typical Bedrock Interpretation from the Geophysical Survey near Turbine T4

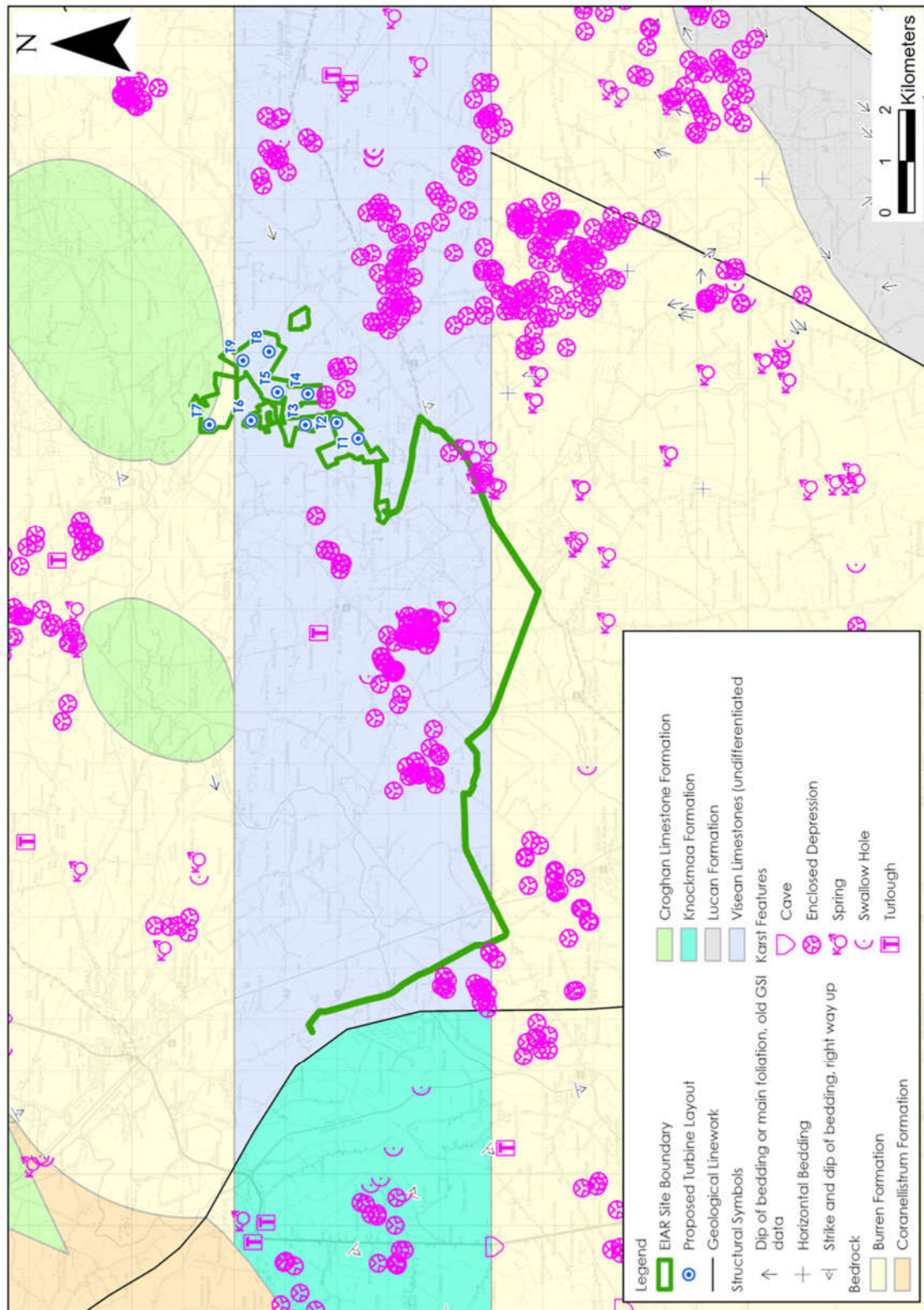


Figure 8-6 GSI Bedrock Geology Map

8.3.4 Karstification

8.3.4.1 Introduction

Karst is defined by Drew (2018)² as a “terrain with distinctive hydrology and landforms due to the high solubility of the rock and the high degree of development of secondary permeability in the aquifer”. The development of karstic landscapes occurs most frequently in very pure, well-fractured limestone, such as the Carboniferous limestone in Ireland, but can form in any carbonate rock susceptible to dissolution.

Solution of the limestone by acidified runoff is the dominant process by which karstic weathering occurs. The degree of solutional erosion varies both across the surface and below the ground. These variations in intensity, combined with the areal variability of the solution processes on different limestone lithologies and structures, produce a variety of karstic landforms on both large and small scales.

However, what’s notable about the known bedrock geology of the Proposed Wind Farm site is that all investigation drilling data available to date (i.e. BH1, BH2 and GSI-17-003) encountered impure argillaceous (i.e. clay impurities) with MUDSTONE. Impure limestone is much less prone to karstification. MUDSTONE is not prone to karstification.

Also, the majority (70%) of the trial pits that encountered bedrock found the bedrock to be competent, unweathered, grey massive LIMESTONE. No epikarst weathering on the top of bedrock was encountered during the trial pitting.

Similarly, the geophysical surveys carried out at the Site found the LIMESTONE to be competent and fresh (i.e. no epikarst or deeper karst weathering/conduits were noted).

8.3.4.2 GSI Karst Database

No GSI mapped karst features are located within the Proposed Project site, however several karst features (‘enclosed depressions’) are mapped by the GSI less than 0.5km to the southeast of the Proposed Wind Farm site (to the southeast of proposed turbine location T4), with a very high density of GSI karst features mapped approximately 2km further to the southeast of the Site. GSI mapped karst features are shown on **Figure 8-6** (Bedrock Geology) above.

Along the Proposed Grid Connection underground cable route there are numerous GSI mapped karst features within a 100m corridor of the underground cable route. However, due to the nature of the Proposed Grid Connection along public roads, with the cable being placed within the road carriageway structure, no karst features are likely to be encountered.

An enclosed depression (also called doline) is a natural enclosed depression typically found in karst landscapes. Dolines are the most common landform in karst areas. They are described as small to medium sized closed depressions, ranging from metres to tens of metres in both diameter and depth.

Once created dolines can sometimes function as funnels, allowing the direct transmission of surface water into the underlying karstic bedrock aquifer. They may occur as isolated features or in clusters causing a pock-marked land surface (Ford and Williams, 2007)³.

² Drew, D. 2018. Karst of Ireland: Landscape Hydrogeology Methods. Published by Geological Survey Ireland.

³ Derek Ford, Paul Williams (2007) Karst Hydrogeology and Geomorphology.

8.3.4.3 GDG Karst Mapping

The GSI karst database is not exhaustive, and additional potential karst features have been identified during field mapping carried out by GDG as part of the Geotechnical Karst Risk Assessment, included as **Appendix 8-2**.

In all, a total of 41 no. potential karst features (enclosed depressions) were mapped by GDG within 1km of the Proposed Wind Farm site. 11 no. potential enclosed depressions were mapped within the Proposed Wind Farm site boundary. Refer to **Figure 8-7** below for the GDG mapped potential karst features.

The 11 no. potential enclosed depressions mapped are also largely focused on the southeast of the Proposed Wind Farm site (same orientation as the off-site GSI mapped karst features to the southeast of the Site), in the area of proposed turbine location T4 and access road.

The potential enclosed depressions present within the Proposed Wind Farm site are typically very shallow (0.5m deep), nearly flat depressions and are present within glacial deposits. The base of the depressions is underlain by several metres of glacial till as demonstrated by the site investigations.

There is no evidence of a swallow hole or any channelling/funnelling of surface water runoff to ground. The larger of the depressions were actually noted to hold surface water during wet periods and therefore they appear to not have a significant surface water drainage function at the Site. The land in this area of the Proposed Wind Farm is also poorly draining due to the CLAY dominated subsoils.

Table 8-10 below summaries the setback distance from key Proposed Project infrastructure locations to the closest mapped potential enclosed depression (on-site or off-site potential karst feature, whichever is closest).

No potential enclosed depressions are located within the proposed footprint of any of the turbine bases or hardstand areas. However, potential enclosed depressions are located along proposed access roads at 2 no. locations north of turbine T4 (features are referred to as K01 and K02 by GDG). These features were investigated further by geophysical surveys.

Table 8-10: Proximity of Potential karst Features to key Infrastructure Locations

Location	Closest Potential karst Feature Distance (m)	Potential Karst Feature Type	GDG karst Feature ID
T1	214	Enclosed Depression	K27
T2	310	Enclosed Depression	K27
T3	410	Enclosed Depression	K15
T4	40	Enclosed Depression	K39
T5	313	Enclosed Depression	K02
T6	820	Enclosed Depression	K08
T7	960	Enclosed Depression	K31
T8	280	Enclosed Depression	K31
T9	340	Enclosed Depression	K31
Onsite 110kV Substation/BESS	510	Enclosed Depression	K27
Temporary Construction Compound	340	Enclosed Depression	K28

8.3.4.4 Geophysical Survey

A geophysical survey was carried out in the area of proposed T4 and access road, where there are a number of ground surface depressions present (potential enclosed depression), including 2 no. depression features present along the turbine T4 access road alignment footprint (features referred to as K01 and K02 by GDG). Features K01 and K02 present as shallow (<0.5m deep), saucer shaped depressions in grassland.

Refer to **Figure 8-7** and **Figure 8-8** below for the geophysical survey locations. The geophysical survey report is attached to the Geotechnical Karst Risk Assessment report (**Appendix 8-2**).

4 no. 2D Resistivity survey lines (R1 - R4) were conducted across the ground surface depressions K01 and K02 to determine if the features are present due to karstification in the underlying bedrock. All 4 no. 2D Resistivity survey lines encountered competent, fresh unweathered LIMESTONE bedrock with no evidence of underlying bedrock karstification.

Refer to **Figure 8-5** above which show 2D Resistivity sections R1 and R2 which crosses these features.

The surveys demonstrate the ground surface depressions present locally in the area of proposed turbine T4 access road are not likely formed by karstification, but a morphological feature of the overburden deposits.

This is also consistent with the findings of trial pits TP01 and TP11 which were carried out at proposed turbine location T4 and access road (refer to **Figure 8-8** below). Both trial pits encountered grey to dark grey, competent, massive LIMESTONE.

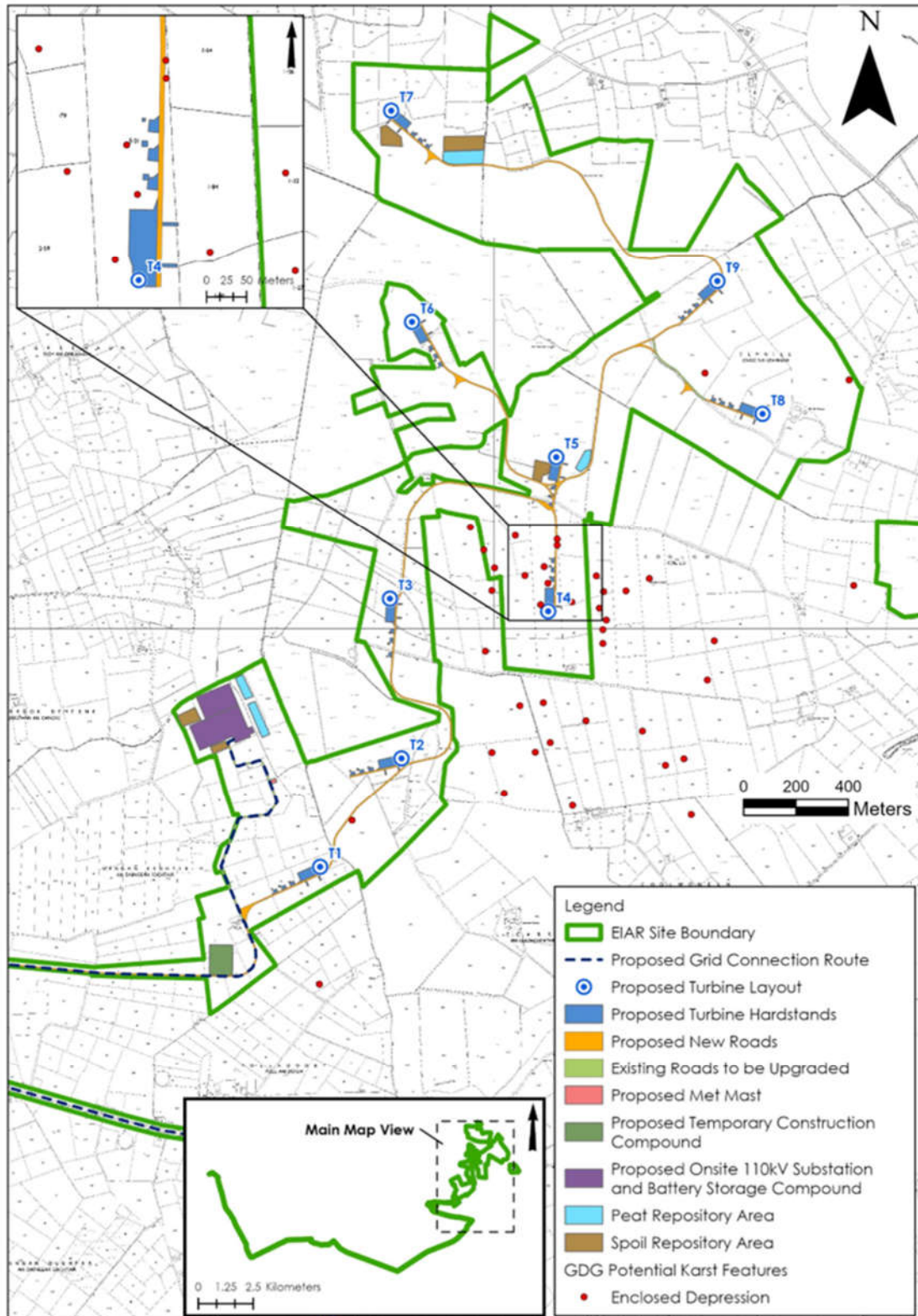


Figure 8-7 GDG Karst Feature Mapping

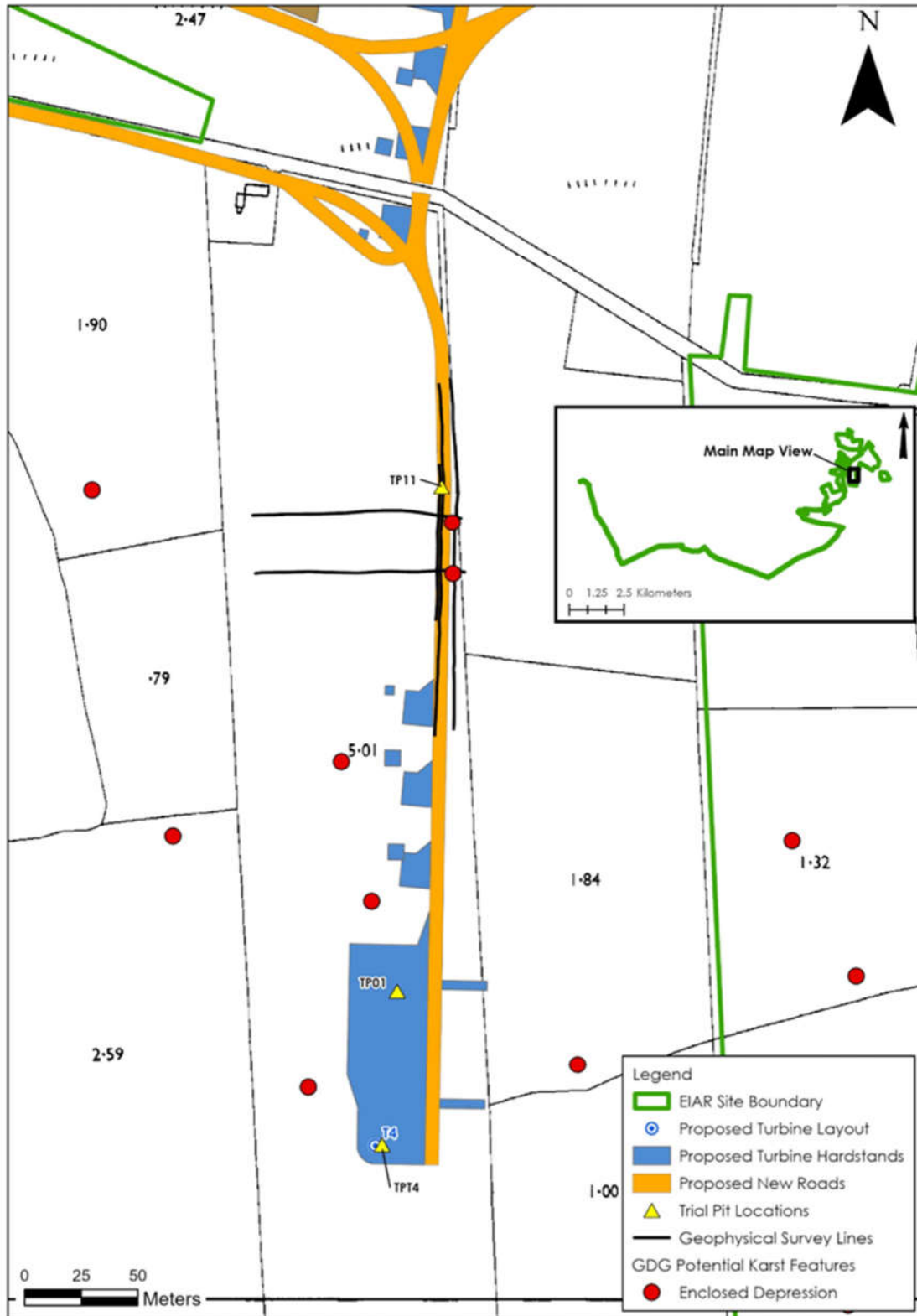


Figure 8-8 Geophysical Survey Locations

8.3.5 Geological Resource Importance

The limestone and mudstone bedrock at the Proposed Project site is classified as “Low” importance. The bedrock could be used on a “sub-economic” local scale for construction purposes. The bedrock in the area is poorly exposed due to the coverage of deep peat and limestone tills.

The peat deposits at the Proposed Project site can be classified as “Low” importance as the peat is not designated in this area and is significantly degraded in most places by peat cutting and drainage. Similar peat deposits are also locally abundant in the surrounding area. Refer to **Table 8-1** for classification criteria.

8.3.6 Geological Heritage & Designated Sites

Within the Republic of Ireland designated sites include Natural Heritage Areas (NHAs), Proposed Natural Heritage Areas (pNHAs), Special Areas of Conservation (SAC) and Special Protection Areas (SPAs). A map of designated sites in the local area is shown as **Figure 8-9** below.

The closest designated site to the Proposed Wind Farm site is Lough Corrib SAC (Site Code: 000297) which includes sections of the Grange River and Abbert River downstream of the Site. Downstream distance to Lough Corrib SAC in the Grange River is 3km and 5.5km in the Abbert River.

The Proposed Grid Connection briefly intercepts Lough Corrib SAC where it crosses over the Grange River via an existing bridge on the R347 approximately 9km to the west of the Proposed Wind Farm site.

Derrinlough Bog SAC (Site Code: 002197) is located approximately 3.5km to the northeast of the Proposed Wind Farm site, while Levally Lough SAC (Site Code: 000295) is located 3.5km to the north.

Killaclogher Bog NHA is located approximately 2.5km to the southeast of the Proposed Wind Farm site where it is located upstream of the Site in the Abbert River catchment.

Derrynagran Bog and Esker geological heritage and NHA is located 2km to the northeast of the Proposed Wind Farm site.

Due to the setback distance to geological heritage sites and designated sites, no direct or indirect effects are likely with regard Land, Soils and Geology.

Potential hydrological/hydrogeological effects on designated sites are discussed in Chapter 9 (Hydrology and Hydrogeology).

All designated sites and geological heritage sites are screened out for further assessment with regard land, soils and geology due to lack of potential direct effects. Indirect hydrological and hydrogeological effects are assessed in Chapter 9 (Hydrology and Hydrogeology).

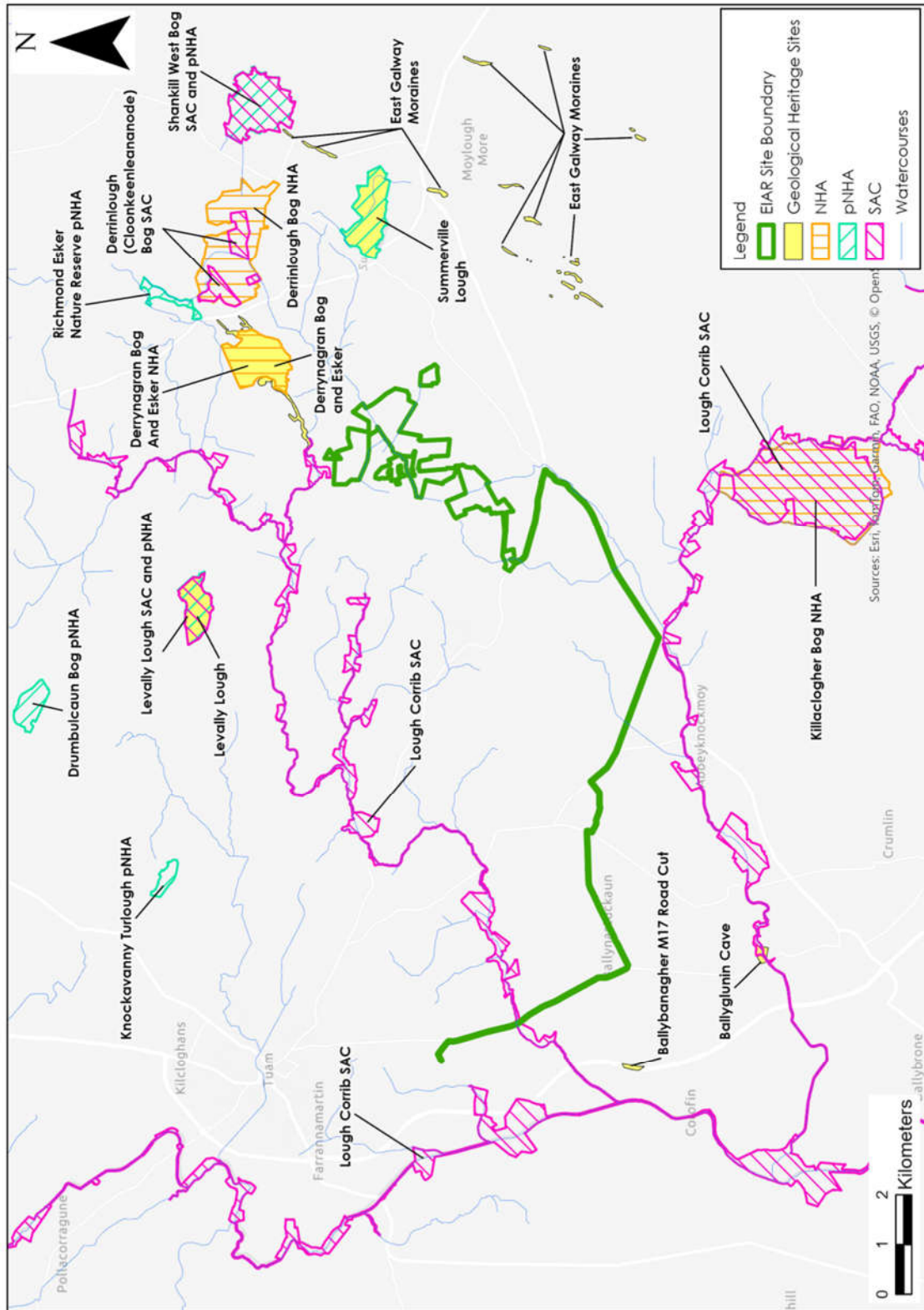


Figure 8-9 Designated Sites and Geological Heritage Sites

8.3.7 Soil Contamination

There are no known areas of soil contamination on the Proposed Project site. During the site walkovers or intrusive investigations, no areas of contamination concern were identified. This was also confirmed by the groundwater sampling and laboratory analysis conducted on the investigation boreholes BH1 and BH2 (refer to the Chapter 9 Hydrology and Hydrogeology).

According to the EPA online mapping (<http://gis.epa.ie/Envision>), there are no licensed waste facilities on or within the immediate environs of the Site.

There are no historic mines at or in the immediate vicinity of the Site that could potentially have contaminated tailings.

8.3.8 Economic Geology

The GSI online Aggregate Potential Mapping Database shows that the Site is located within an area mapped as being typically Very Low to Low in terms of crushed rock aggregate potential and with no potential for granular aggregate potential (i.e. potential for gravel reserves).

8.3.9 Geohazards

The GSI Landslide database (www.gsi.ie) does not record any historic landslides in the vicinity of the Site or in the surrounding lands.

The GSI Landslide Susceptibility Map (www.gsi.ie) classifies the probability of a landslide occurring at a given location. The entirety of the Proposed Wind Farm site is mapped as having low susceptibility due to the low slope angles encountered.

Refer to Section 8.3.10 below for a summary of the Peat Stability Risk Assessment (**Appendix 8-1**) which was carried out by GDG. All Proposed Project infrastructure elements are located in areas of negligible risk of peat instability.

A Geotechnical Karst Risk Assessment was completed by GDG (**Appendix 8-2**) for the Proposed Project. The Overall Karst Risk Rating (post-mitigation) calculated by GDG is Low to Medium.

Refer to Section 8.3.11 below for a summary of the Geotechnical karst Risk Assessment.

8.3.10 Peat Stability Risk Assessment

8.3.10.1 Introduction

Gavin and Doherty GeoSolutions (GDG) were engaged to undertake a Peat Stability Risk Assessment for the Proposed Project site. A Peat Stability Risk Assessment (PSRA) Report (GDG, 2025) is attached as **Appendix 8-1**. This section of the chapter is a summary of the Peat Stability Assessment Report carried out by GDG.

Hydrological, hydrogeological and ecological factors were considered in the PSRA, and regular interaction between HES and MKO were undertaken throughout the iterative design process (i.e. hydrological constraints mapping). The assessment was done in accordance with Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments (PLHRAG, Scottish Government, 2017).

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 on the Site, prior to the site reconnaissance by engineering geologists/geotechnical engineers from GDG.

The peat stability assessment is carried out by using a deterministic (Factor of Safety) approach.

8.3.10.2 Peat Stability Desk Study

The GSI landslide inventory (GSI, 2022a), the multi-temporal aerial / satellite imagery, the DEM, the landslide susceptibility map (GSI, 2016), and the rainfall information of Met Éireann data 1981-2010 were used for this part of the desk study.

The GSI mapping (refer to Figure G-1 in Appendix G of the PSRA) illustrates the landslide susceptibility (GSI, 2016) across the Site. This map was obtained by using an empirical probabilistic method at a regional scale and should provide input into site-specific scale engineering studies. The entirety of the Proposed Wind Farm site is mapped as having low susceptibility due to the low slope angles encountered. Field visits by the GDG geotechnical team noted no visual signs of slope instability at the time of the visits (2022-2025).

Figure G-2 in Appendix G depicts the spatial relationship between records of previous landslide events (GSI, 2022a, 2022b) and rainfall across Ireland from the Met Éireann (2018) average annual rainfall dataset. The study area is in a region of moderately high rainfall and relatively flat topography.

According to the GSI landslide inventory (GSI, 2022), the closest landslide is located around 12km north of the closest turbine (T1) and around 11.8km from the Proposed Wind Farm site, in Dunmore, Co. Galway. The exact area of the peat slide was not recorded, but it is recorded to have occurred in 1873 and “moved quickly first and continued slowly for 11 days” (Praeger, 1893). This landslide resulted in the peat “burying three farmhouses and covering about 300 acres of pasture and arable land, 6 feet deep”. No other significant information is available, but this location appears to be a relatively flat, deep raised peat bog, and therefore, the failure mechanism was likely a margin rupture (Warburton et al. 2004) triggered bog burst event caused by the extraction of peat from the raised bog due to steep cuttings (7-9m high), removing toe support for the high raised bog.

An additional historic landslide is recorded 11.8km southwest of the Proposed Wind Farm site, at Kilmore, Co. Galway. This landslide is noted as having occurred in cut-over raised peat in 1909, but no other details are available from the GSI database.

8.3.10.3 Peat Stability Investigations

A walkover including intrusive peat depth probing, an intrusive ground investigation comprising trial pit and a stability analysis and risk assessment was carried out by GDG to assess the susceptibility of the Proposed Project site to peat failure following the principles in PLHRAG.

The assessment involved slope stability analysis at over 344 locations across the Site. The peat depth distribution across the Site is discussed in Section 0 above.

8.3.10.4 Peat Stability Analysis

The purpose of the analysis was to determine the Factor of Safety (FoS) of the peat slopes. The minimum required Factor of Safety (FoS) is 1.3 based on BS6031:1981: Code of Practice for Earthworks (BSI, 2009). Refer to **Table 8-11** below.

GDG have completed an analysis of peat sliding at all the main Proposed Project infrastructure locations (Proposed Wind Farm site and Proposed Grid Connection) for both the undrained and drained conditions as explained further below.

The factor of safety provides a direct measure of the degree of stability of a slope by the ratio of the shear resistance along a potential surface of failure and the landslide driving forces acting on such surface. Multiple potential surfaces of failure are possible, but the FoS assigned to a slope is that of the surface of failure with the lowest value of FoS:

- $FoS < 1$ indicates a slope is unstable and prone to failure.
- $FoS = 1$ indicates a slope is theoretically stable but not safe.
- $FoS \geq 1.3$ indicates the acceptable safety threshold. The previous code of practice for earthworks BS 6031:1981 (BSI, 1981) provided advice on the design of earthworks slopes. It stated that for a first-time failure with a good standard of site investigation, the design FoS should be greater than 1.3. This way, the slope is stable and safe.

Table 8-11: Probability Scale for Factor of Safety.

Factor of Safety limits	Slope stability
$FoS < 1$	Unstable
$1 \leq FoS < 1.3$	Stable but not safe
$FoS \geq 1.3$	Stable and safe

8.3.10.5 Peat Stability 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 undrained⁴ (short-term stability) and drained (long-term stability) analysis has been undertaken to determine the stability of the peat slopes on-site.

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

As mentioned above, the Peat Stability Risk Assessment Report (GDG, 2025) is attached as **Appendix 8-1**.

8.3.10.5.1 Undrained Analysis

The results of the undrained analysis for the peat at the Proposed Wind Farm site infrastructure locations are presented in **Table 8-12**. The undrained analysis was undertaken for 2 no. conditions:

⁴ For the stability analysis two load conditions were examined, namely:

Condition (1): no surcharge loading

Condition (2): surcharge of 10 kPa, equivalent to 1 m of stockpiled peat assumed as a worst case.

Condition 1 with no surcharge loading and Condition 2 with a surcharge loading of 10kPa, equivalent to 1m of stockpiled peat.

The FoS has also been calculated semi-automatically in Geographical Information Systems for the entire site (the methodologies are detailed in **Appendix 8-1**) and provides an FoS for other features such as hardstands areas and access roads.

The spatial distribution of the FoS values for Condition 1 show almost all investigation locations to be stable and safe (FoS > 1.3, green). There are some small areas alongside the access track (approx. 5m away from access track) between T5 and T6 which show FoS values between 1 and 1.3 (yellow: stable but not safe). Also, small areas alongside the access track between T5 and T6 have FoS values <1 (red: not stable) but are 5m away from the access track. Large areas of the Proposed Wind Farm site (e.g. at T1, T4 and T8) do not have FoS scores. This is because no peat is present in these locations; therefore, no value could be calculated.

For Condition 2 almost all investigation locations are shown to be stable and safe (FoS > 1.3, green), but there is one section within the access track between T5 and T6 which shows FoS values between 1 and 1.3 (yellow: stable but not safe). A small number of small areas within the access track between T5 and T6 have FoS values <1 (red: not stable). Areas in the undrained scenario (e.g. T1, T4 and T8) which did not have FoS values without surcharge are assigned values in this scenario, as the placement of 1m of peat is simulated.

These risk areas are caused by localised factors which have been examined in more detail in Section 0 of the PSRA (**Appendix 8-1**). Where required additional mitigation, including exclusion zones and peat storage restriction areas have been scheduled which the designer and contractor must adhere to at the construction stage.

Table 8-12: Factor of Safety Results (undrained condition)

Location	Factor of Safety for Load Condition	
	Condition (1)	Condition (2)
T1*	n/a (no peat)	12.47
T2	16.86	8.43
T3	205.81	75.55
T4	n/a (no peat)	57.3
T5	21.22	12.73
T6	n/a (no peat)	22.04
T7	n/a (no peat)	30.16
T8	n/a (no peat)	15.09
T9	17.64	9.8
Substation/BESS	292.64	26.6
Construction Compound	n/a (no peat)	23.88

Location	Factor of Safety for Load Condition	
	Condition (1)	Condition (2)
Met mast	n/a (no peat)	9.26

*FoS for turbine base locations

8.3.10.5.2 Drained Analysis

Drained analysis results are presented in **Table 8-13**. 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.

For Condition 1 almost all investigation locations are shown to be stable and safe (FoS > 1.3, green), but there is one section within the access track between T5 and T6 which shows FoS values between 1 and 1.3 (yellow: stable but not safe). One small area within the access track between T5 and T6 has FoS values <1 (red: not stable). Large areas of the Proposed Wind Farm site (e.g. at T1, T4 and T8) do not have FoS scores. This is because no peat is present in these locations; therefore, no value could be calculated.

For Condition 2 almost all investigation locations are shown to be stable and safe (FoS > 1.3, green), but there is one section within the access track between T5 and T6 which shows FoS values between 1 and 1.3 (yellow: stable but not safe). There are no pixels within any proposed infrastructure which show FoS values <1 (red: not stable). Areas in the drained scenario (e.g. T1, T4 and T8) which did not have FoS values without surcharge are assigned values in this scenario, as the placement of 1m of peat is simulated.

These risk areas are caused by localised factors which have been examined in more detail in Section 0 of the PSRA. Where required additional mitigation, including exclusion zones and peat storage restriction areas have been scheduled which the designer and contractor must adhere to at the construction stage.

Table 8-13: Factor of Safety Results (drained condition)

Turbine No./Waypoint	Factor of Safety for Load Condition	
	Condition (1)	Condition (2)
T1*	n/a (no peat)	21.59
T2	13.8	14.76
T3	166.87	131.71
T4	n/a (no peat)	99.27
T5	17.57	22.42
T6	n/a (no peat)	38.18
T7	n/a (no peat)	52.52
T8	n/a (no peat)	26.13
T9	14.52	17.2

Turbine No./Waypoint	Factor of Safety for Load Condition	
	Condition (1)	Condition (2)
Substation/BESS	236.66	46.14
Construction Compound	n/a (no peat)	41.37
Met mast	n/a (no peat)	16.02

*FoS for turbine base locations

8.3.10.5.3 **Assessment and Interpretation of FoS Results**

The interpretation of the factor of safety analysis and accurate assessment of the peat stability conditions is a semi-automated approach that combines the developed polygon areas of the FoS results, areas of risk identified during the site walkovers, and potential risk areas identified from the examination of peat depths and site topography. It is noted that the results from all FoS analyses (drained/undrained, with and without surcharge) are used, highlighting any areas indicative as having a FoS of less than 1.3 in the worst-case surcharged condition with 10kPa. These areas were then cross-examined with the observations from the site visits and topographic models.

This analysis was used throughout the development process to aid in the siting and design of the proposed development layout including turbines, hardstands, and other key infrastructure locations. The undrained scenario with a 1m peat surcharge has been considered as the critical scenario. However, the FoS of all elements of the site was examined in both the drained and undrained conditions.

In all the modelled FoS scenarios, areas of FoS <1.3 are rare, and are generally localised to peat cut faces of banks or linear features such as ditches or land drains. The Proposed Wind Farm site layout avoids all areas of FoS <1.3 in all scenarios, with the exception of one localised section of the access track between T5 and T6. This access track interacts with a very small area of 1 < FoS <1.3 at a minor water crossing.

Localised areas of the Proposed Wind Farm site contain flat-lying, deep peat with active peat cutting. Steep peat cuttings of <1m generate low factors of safety but are generally considered low landslide risk. Raised bog environments like this Site may be susceptible to bog burst type failures, which can occur at very low slope angles and may not be fully quantified by the FoS calculation, as they are driven by hydrological factors rather than slope-driven. For this reason, the locations were assessed on-site and 'ground-truthed' to identify true hazards. GDG site walkovers identified no evidence of significant bog burst features.

The lack of evidence for historical bog bursts does not preclude the possibility that these may occur. Further inspection will be required during the detailed design and construction stage to inspect for peat instabilities, including bog burst features. This will be carried out by the detailed Designer and the Contractor's team. The design team shall develop their own inspection and testing criteria to satisfy and de-risk the possibility of peat landslides at these locations.

8.3.10.6 **Overall Risk Rating**

The procedure behind risk rating calculation is described in Section 6 of the attached PSRA report.

Risk for each Proposed Project infrastructure element is calculated. The risk rating ranges between 0 and 1 and the following levels of risk rating have been distinguished:

- High (0.6 to 1): Avoid project development at these locations. Mitigation is generally not feasible.
- Medium (0.4 to 0.6): The project should not proceed unless risk can be avoided or mitigated at these locations without significant environmental impact to reduce risk ranking to low or negligible.
- Low (0.2 to 0.4): Project may proceed pending further investigation to refine assessment and mitigate hazard through relocation or re-design at these locations.
- Negligible (0 to 0.2): The project should proceed with monitoring and mitigating peat landslide hazards at these locations as appropriate.

All Proposed Project infrastructure elements are located in areas of negligible risk as shown in **Figure 8-10**, **Figure 8-11** and **Figure 8-12** below.

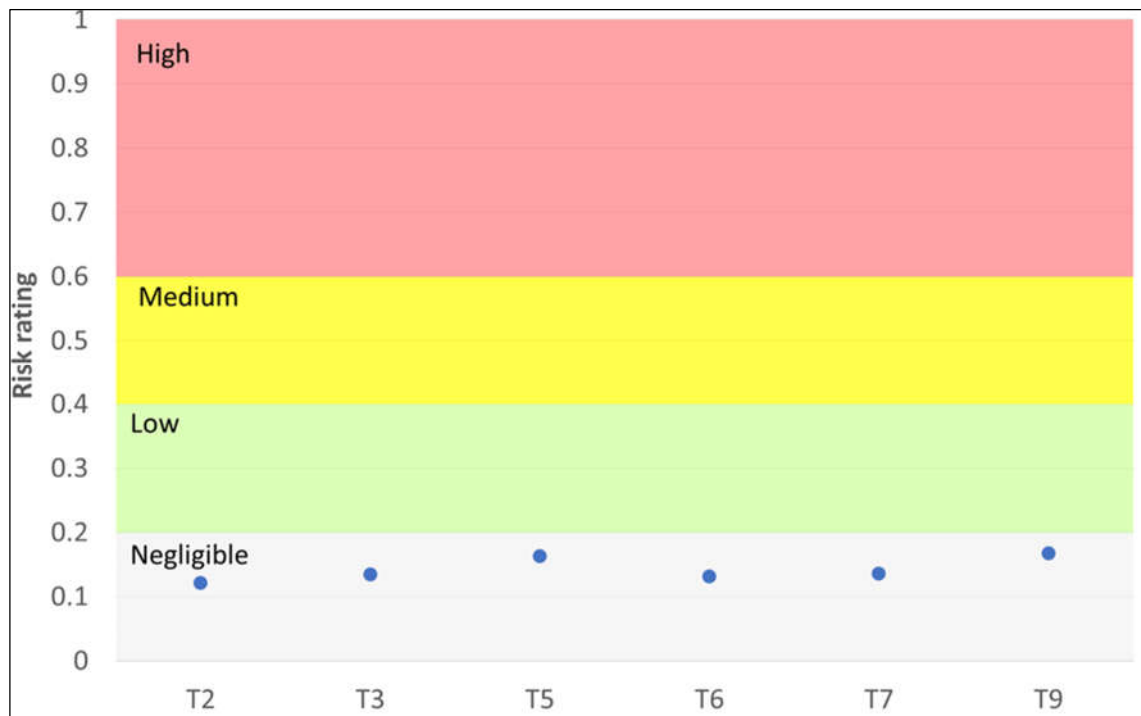


Figure 8-10 : Risk Rating at Proposed Turbine Locations (GDC, 2025)

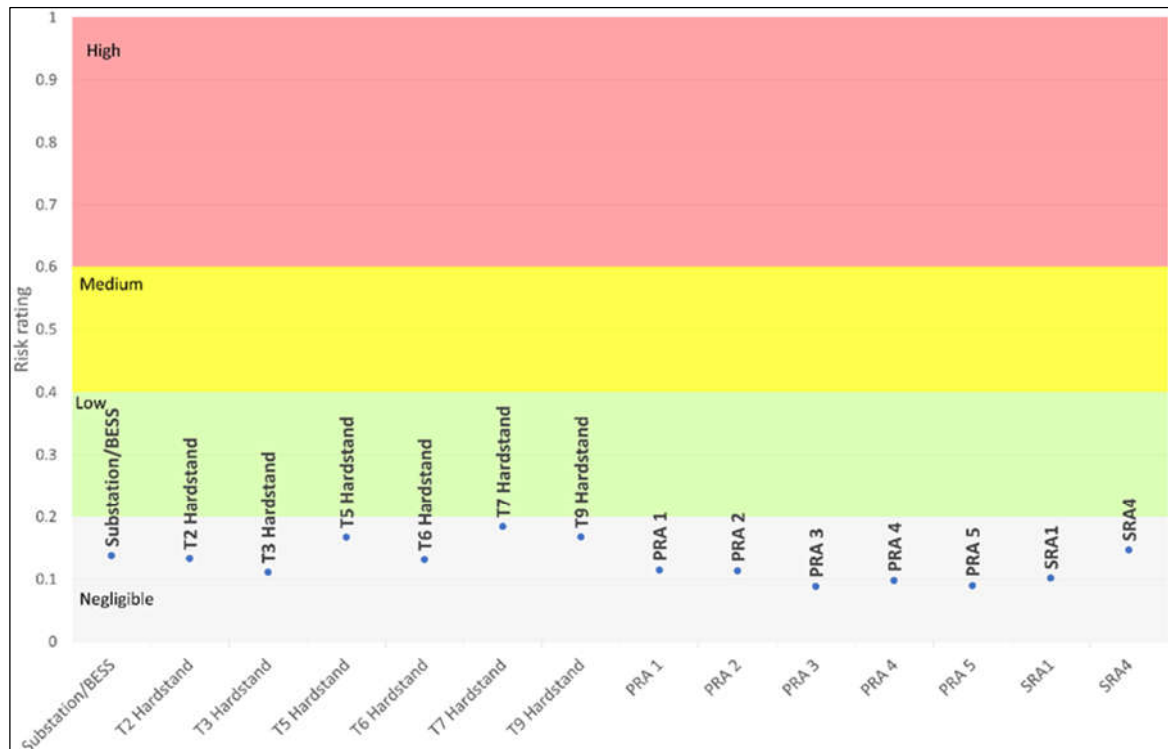


Figure 8-11 : Risk Rating at Wind Farm site Infrastructure Locations (GDG, 2025)

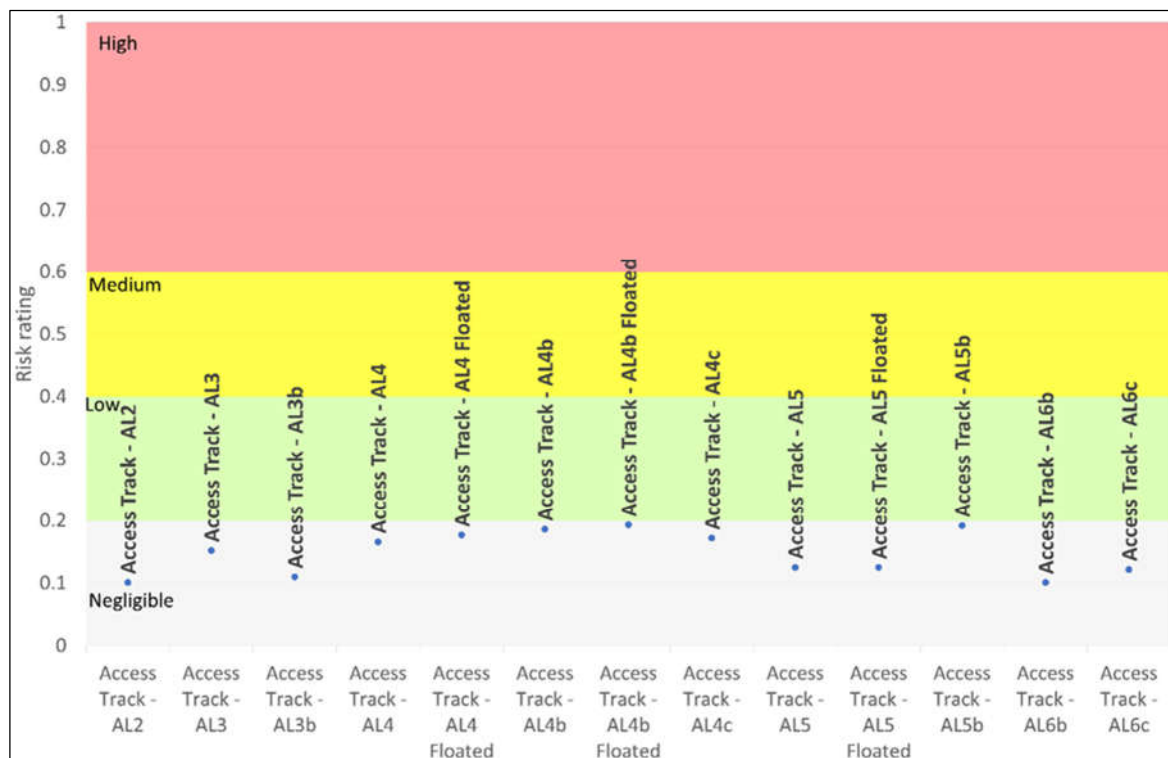


Figure 8-12 : Risk Rating at Proposed Wind Farm site Access Track Locations (GDG, 2025)

8.3.11 Geotechnical Karst Risk Assessment

8.3.11.1 Introduction

Gavin and Doherty GeoSolutions (GDG) were engaged to undertake a Geotechnical Karst Risk Assessment of the Proposed Wind Farm site.

A Geotechnical Karst Risk Assessment Report (GDG, 2025) is attached as **Appendix 8-2**. This section of the chapter is a summary of the risk assessment carried out by GDG.

In the GDG assessment, a qualitative approach has been pursued to produce a high-level estimate of the karst risks associated with the Proposed Wind Farm site. The factors that determine the hazard and the consequences need to be transformed into subjective ratings.

The karst hazard assessment methodology is compiled by assessing geological attributes likely to give rise to karst hazards, such as the presence of existing or known karst features as determined from site observations, trial pits and other information sources.

8.3.11.2 Hazard Assessment

The karst hazard has been based on an assessment of the following geological and evidence-based risks outlined in **Table 8-14** below. This hazard assessment has been completed in the absence of detailed confirmatory intrusive ground investigation and shall be revised accordingly by a suitably qualified geotechnical engineer following detailed ground investigation, at the detailed design stage. Rankings have been assigned to each of the parameters, and these have been multiplied together to form a karst hazard assessment matrix, to which ratings of negligible, low, medium, high and very high have been applied.

A detailed description of the scoring methodology for each contributing factor is given in Sections **Error! Reference source not found.** and **Error! Reference source not found.** of the GDG report and are summarised in Section 8.3.11.3 below. The methodology is based on that proposed by Rutty and Jennings (2012).

8.3.11.3 Hazard Rating

The following sections outline the factors that were considered in order to classify the risk rating based on geological factors. The selection of these factors is based on previous assessments carried out on large infrastructure projects in Ireland (Rutty and Jennings; 2012; Madden and O'Hara, 2016).

8.3.11.3.1 Underlying Rock Type

The entirety of the Proposed Wind Farm site is mapped as being underlain by pure limestone bedrock, which is potentially prone to karstification. The rock is classified as pure bedded Dinantian Limestone of the Croghan Formation, Burren Formation, and Undifferentiated Visean Limestone (likely Croghan Formation).

As the entirety of the Proposed Wind Farm is underlain by pure limestones, the entire Proposed Wind Farm site, including all infrastructure. A score of 2 is assigned for the Proposed Wind Farm site.

However, what's notable about the known bedrock geology of the Proposed Wind Farm site is that all investigation drilling data available to date (i.e. BH1, BH2 and GSI-17-003) encountered impure argillaceous (i.e. clay impurities) with MUDSTONE. Impure limestone is much less prone to karstification. MUDSTONE is not prone to karstification. The above score of 2 is therefore conservative.

8.3.11.3.2 Proximity to Faults/Geological Boundaries

For the purposes of this KRA, a 100m buffer has been applied to all faults and formation changes mapped by the GSI. A score of 1 is assigned to any areas which fall outside of the 100m buffer for any formation change, while a score of 2 is applied to any area that falls within the 100m buffer.

Bedrock geological boundaries between the Croghan Formation, Burren Formation and Undifferentiated Viséan Limestone Formation are mapped by the GSI in the northern part of the Proposed Wind Farm site; however, only turbine T7, hardstand and portions of the adjacent access tracks fall within a 100m buffer of these boundaries. A score of 1 – 2 is assigned to the Proposed Wind Farm site.

8.3.11.3.3 **Thickness of Overburden Cover**

Bedrock has not been proven at depths greater than 5m below ground level (bgl) in any trial pit or borehole location; however, peat probes have encountered peat/soft clay deposits of greater than 5m in thickness in some instances, particularly in the area between T5, T7, and T9. A score of 2 – 3 is assigned to the Proposed Wind Farm site.

8.3.11.3.4 **Overburden Type**

The Proposed Wind Farm site is split relatively evenly between areas mapped by the GSI as consisting of peat and areas mapped as till. Turbines T1, T3, T4, T6 and T8 are mapped as till, with T2, T5, T7 and T9 mapped as peat. Localised areas of <1m of overburden are identified from trial pits close to T1 and at the substation. A score of 1 – 2 is assigned to the Proposed Wind Farm site.

8.3.11.4 **Evidence Based Hazard Rating**

The following sections outline the factors considered in classifying the rating based on karst evidence.

8.3.11.4.1 **Density of identified karst Features**

As outlined previously, 43 no. potential karstic features have been identified within a 1km buffer of the Proposed Wind Farm site. The number of identified karst features within 250m of each pixel has been determined using ArcGIS Pro, and score classes assigned. For infrastructure-specific analysis, the number of karst features within a 250m buffer of each infrastructure location has been considered.

A 250m buffer has been used for this analysis as this is considered to provide a localised yet sufficiently broad spatial context to capture nearby karst features that may pose indirect or cumulative risks to infrastructure. A high density of karst features within 250m indicates that the development of karstic features at the location being assessed is more likely.

Karst features were identified within 250m of T1, T2 hardstand, T4, T5 hardstand, T8 handstand, and various sections of access track alignment.

The highest density of karst features was recorded in the area surrounding T4 and access track alignment to the north, with >4 features recorded within 250m of these locations (12 features are recorded within 250m of T4).

8.3.11.4.2 **Interaction karst Features**

A 10m buffer was applied to all identified karst features. Areas within the 10m buffer were classed as being within karst features.

Identified potential karst features (K01 and K02) were only found to overlap with the Proposed Wind Farm infrastructure in one location at access track alignment to the north of turbine T6 (AL6).

Geophysical surveying carried out in August 2025 (Section **Error! Reference source not found.** of KRA) found no evidence for large karstic cavities beneath the AL6 alignment, at the K01 and K02 locations. As a result, these features were removed from the Karst Interaction scoring.

Table 8-14: Karst Hazard Assessment (Taken from GDG, 2025)

Hazard factors		Description	Max Possible Score	Wind Farm Score
Geological Factors	A. Underlying rock type	Susceptibility of the underlying bedrock to karstification.	2	2
	B. Proximity to mapped geological faults/boundaries	The geological structure of the bedrock can influence its susceptibility to karstification. Discontinuities such as faults, joints, or significant geological boundaries can initiate the formation of fissures, which can be exploited by water and begin the process of dissolution.	2	1 - 2
	C. Thickness of overburden cover	The thickness of overburden cover is considered to influence the distribution of karst features (Burke, 1998; Zhou et al., 2003). This is likely to be caused by a combination of factors, with existing features buried and obscured by the deposition of soil cover during the Quaternary. Thick soil cover may also protect the limestone and prolong the process of sinkhole formation.	3	2 - 3
	D. Overburden cover type	The material characteristics of the overburden cover can directly influence the likelihood and potential severity of karstic features for construction. This is because different soil types can directly influence the form of karstic features (particularly sinkholes/dolines/enclosed depressions) that may develop.	2	1 - 2
Geological Factor Total (A×B×C×D)			24	4 - 12
Evidence Factors	E. Density of identified karst features	A high density of karst features within 250m indicates that the development of karstic features at the location being assessed is more likely.	4	1 - 4

Hazard factors		Description	Max Possible Score	Wind Farm Score
	F. Interaction with identified karst features	Karst features recorded as overlapping with the Proposed Development footprint pose a direct risk to the proposed infrastructure.	3	1
Evidence Factor Total (E×F)			12	1 - 4
Hazard Score Total (Geological x Evidence Factor Scores)			288	4 (Low) – 48 (High)

For the Proposed Wind Farm site karst hazard score rating ranges between 4 (Low) to 48 (High). The hazard score ratings are shown graphically in 8.3.11.4.3 below.

8.3.11.4.3 **Pre-Mitigation Hazard Assessment Results**

As outlined in Section **Error! Reference source not found.** of the KRA report, an overall hazard score has been calculated by multiplying the geological hazard score and the evidence-based hazard score. The site-wide hazard calculation is presented in Figure H-7 in Appendix H of the GDG report. The full risk matrix at each location is included in Appendix H of the GDG report.

A summary of the pre-mitigation hazard score calculated at each proposed infrastructure element is outlined in **Figure 8-13** and **Figure 8-14** below.

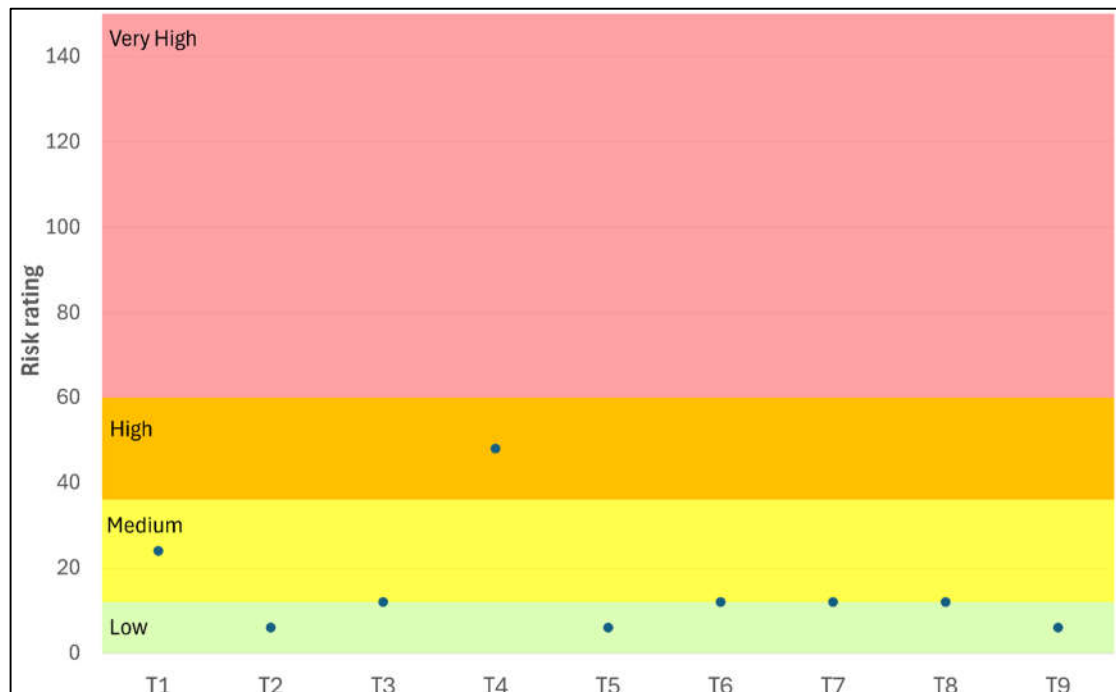


Figure 8-13 : Pre-mitigation Karst Hazard Rating at Wind Farm site Infrastructure Locations (GDG, 2025)

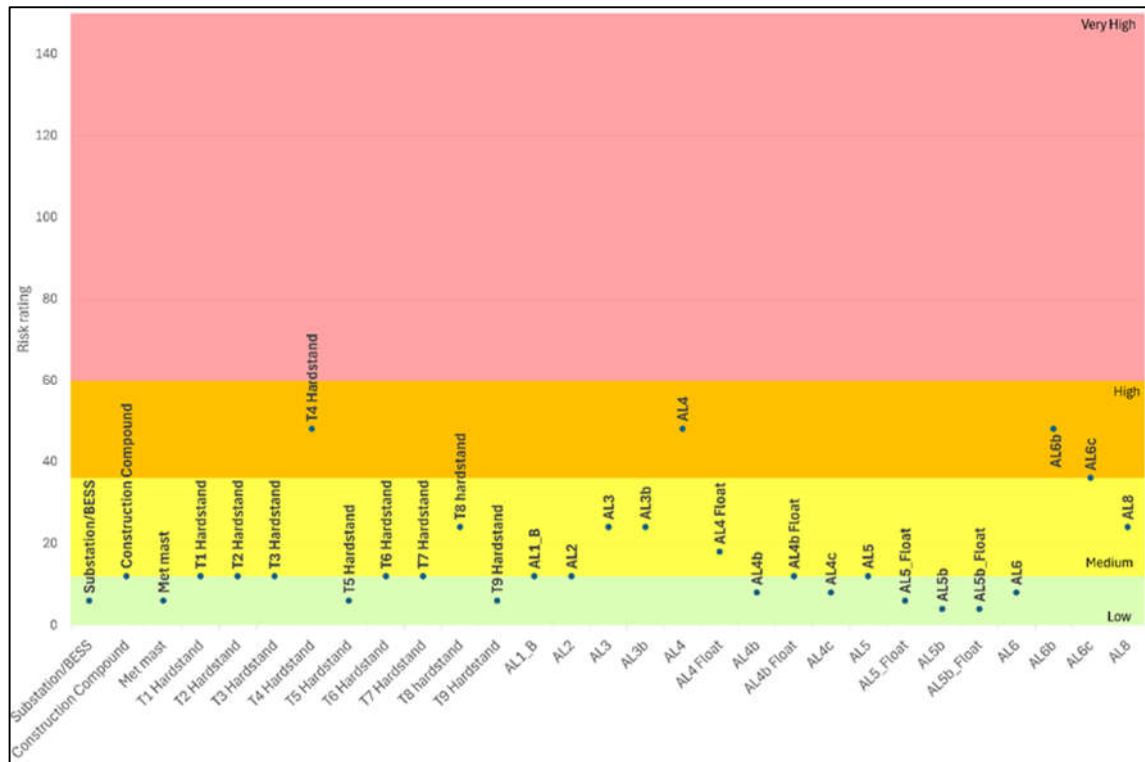


Figure 8-14 : Pre-mitigation Karst Hazard Rating at Proposed Wind Farm site Access Track Locations (GDG, 2025)

The identified karst hazard at the Proposed Wind Farm site is generally classed as low; however, portions of the Proposed Wind Farm site, particularly in the vicinity of T1 and T8, are classified as medium hazard.

A portion of the centre of the Proposed Wind Farm site, in the vicinity of T4, is calculated to have a high hazard rating.

8.3.11.5 Overall karst Risk Rating Result

Following the calculation of the hazard and adverse consequence scores at each location, for the individual identified risks, an overall risk score prior to the implementation of mitigation measures has been calculated.

The calculated overall karst hazard scores range from Medium to High. Post mitigation the overall karst risk scores range from Low to Medium (see Section 8.5.2.6 below for mitigation measures).

Characteristics of the Proposed Project

The Proposed Project construction will mainly involve removal of soils, peat and mineral subsoils for access roads, underground cabling, turbine hardstanding areas, turbine foundations, substation foundations, BESS foundations, construction compound and drainage works. Crushed rock for construction purposes will be sourced off-site from local quarries.

Generally during turbine construction, soil, peat and subsoil will be excavated to a competent stratum for the concrete turbine foundation and a small working area surrounding the foundation footprint. Turbine bases are expected to be gravity bearing bases, pending future detailed site investigations, which may require alteration of the turbine base type.

Similarly, all turbine crane hardstands will 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 reused to batter the platform edges and landscape the platform back into the existing topography.

Estimated volumes of peat and spoil generated during construction are presented in the GDG Peat and Spoil Management Plan (**Appendix 4-2**), along with proposals for handling and storing excavated peat/spoil and recommendations for good construction practices.

It is calculated that the total peat excavation volume will be $39,530\text{m}^3$, while the total spoil excavation volume will be $75,300\text{m}^3$. Refer to

Table 8-15 below for a summary of where the peat/spoil volumes are generated.

It is assessed that the total capacity for placement/ storage and reinstatement of peat is 44,380 m³ and 77,550m³ for spoil, leading to an overall surplus capacity for peat and spoil storage at the Proposed Wind Farm site. The peat management assessment findings indicate that all the peat and spoil material excavated can be placed safely on-site during construction.

Peat and spoil generated during construction will be reused or reinstated across the Proposed Wind Farm site. Peat and soil will be reused for landscaping on edges of constructed infrastructure (including access track verges and around hardstand areas) and shall be placed as soon as reasonably practical after construction.

Any excess peat and spoil will be placed in 4 no. dedicated Peat Repository Areas (PRAs) and 5 no. dedicated Spoil Repository Areas (SRAs).

Any spoil generated from the Proposed Grid Connection cable trenching within the Proposed Wind Farm site will be stored at the Site. All road cuttings/spoil from public road section of the cable route will be sent to a licensed waste facility.

The TDR haul route works will require minor excavations on the N63/R332 junction, where a temporary road will be required just south of Horseleap Lough. There is also an overrun area on the R332 at the proposed Site entrance.

Further details are provided in the Peat and Spoil Management Plan for the works which is included in **Appendix 4-2**.

Table 8-15: Summary of Excavated Peat and Spoil Volumes for Proposed Project (GDG, 2025)

Infrastructure Item	Excavated spoil volume (m ³)	Excavated peat volume (m ³)*
Floated Access Tracks - New	0	0
Founded Access Tracks- Existing Tracks	0	0
Founded Access Tracks -New Tracks (Including widening)	11,380	15,490
WTG Foundations	14,270	2,480
WTG Hardstands	28,970	17,450
Met mast	290	0
Substation and BESS Compound	16,700	4,110
Temporary Construction Compound	3,690	0
Peat and Spoil Repository Areas	0	0
Total	75,300	39,530

Note: The volume of peat material excavated has been estimated using the average peat depth calculated across the footprint of the structure to define the basal surface of the peat.

8.5 Likely and Significant Impacts on Land, Soils and Geology

8.5.1 'Do Nothing' Scenario

If the Proposed Project were not to proceed, peat cutting and forestry plantation operations will continue and may be extended to occupy a larger portion of the Site. Forestry will be felled as forestry compartments reach maturity. Re-planting of these areas is likely to occur. Agricultural practices will continue.

The land, soils and geology would remain largely unaltered as a result of the Do-Nothing Scenario.

8.5.2 Construction Phase - Likely Impacts and Mitigation Measures

The likely impacts of the Proposed Project and mitigation measures that will be put in place to eliminate or reduce them are shown below.

The impact assessment below assesses the overall Proposed Project as the Proposed Wind Farm and Proposed Grid Connection are not likely to be constructed as separate projects.

8.5.2.1 Effects on Land and Land use (Proposed Project)

A summary of lands and habitat types to be lost as a result of the Proposed Project (Proposed Wind Farm site and Proposed Grid Connection) as shown in **Table 8-16** below. There will be no effects on

the lands adjoining the Proposed Project site. Turf cutting, agriculture and forestry will continue during the construction of the Proposed Project.

Overall effects on agricultural landuse (grassland and arable) are not significant with a total loss of 12%. The largest loss relates to forestry due to the small area of existing forestry within the Site.

Table 8-16: Summary of Land and Habitat Loss due to the Proposed Project

Habitat	Total Area (Ha) within the EIAR study boundary	Area (ha) to be lost to development footprint	% of total to be lost
Improved agricultural grassland	140.04	8.77	6
Wet grassland	37.25	3.05	8
Dry meadows and grassy verges	7.6	1.85	24
Arable Crops	13.54	0.81	6
Cutover bog	42	2.12	5
Scrub	0.86	0.06ha	6
Conifer plantation	15.94	11.25ha	70.5
Broadleaved Woodland	3.80	0.17	4

Pathway: Land take

Receptor: Land and Landuse (i.e. the land upon which the Proposed Project will occur)

Potential Pre-mitigation Impact: Negative, slight to moderate, direct, likely, permanent impact on land and landuse.

Impact Assessment/Mitigation

The loss of agricultural land and forestry resulting from the Proposed Project on a local or regional scale is minimal and therefore the effects of actual agricultural land loss is negligible.

The overall Site area is extensive while the Proposed Project footprint (8.75ha) is approximately 2.3% of the overall EIAR Study Area of 376.5ha.

A Biodiversity Management and Enhancement Plan (BMEP) has been prepared for the Proposed Project and is included as Appendix 6-4 of this EIAR. This plan has been developed to offset the loss of habitats identified within the Proposed Wind Farm site and further enhance the biodiversity of the Proposed Wind Farm and its environs. Refer to Section 8.5.2.8 for summary details on the BMEP.

Residual Impact: Due to the small footprint of the Proposed Project on a local scale the final effect is negative, direct, slight, likely, permanent impact on land and landuse. The land and landuse along the Proposed Grid Connection underground electrical cabling route will not change (As the cable will be emplaced within an existing roadway).

Significance of Effects: For the reasons outlined above, no significant effects on land or landuse will occur as a result of the Proposed Project.

8.5.2.2 **Peat, Subsoil and Bedrock Excavation (Proposed Project)**

There will be excavations required for both the Proposed Wind Farm and Proposed Grid Connection (Proposed Project) and therefore both are assessed herein.

Excavation of soil, peat, subsoil and bedrock will be required for construction of works for the installation of access roads, foundations for turbine bases, crane hardstands, substation, construction compounds, grid connection cable, internal cable network and site drainage network.

This will result in a permanent removal and relocation of in-situ peat, soil and subsoil at most excavation locations. Estimated volumes of peat and spoil to be relocated are summarised above in

Table 8-15. There will be no net loss of peat or subsoil, it will just be relocated within the Site. There is no proposed on-site borrow pit.

Pathway: Extraction/excavation.

Receptor: Peat, soil, subsoil and bedrock.

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

Proposed Mitigation Measures by Design:

- Placement of turbines and associated infrastructure in areas with shallower peat where possible;
- Use of floating roads, where appropriate, to reduce peat excavation volumes;
- The peat and subsoil which will be removed during the construction phase will be localised to the wind farm infrastructure turbine location, substation and temporary compounds and access roads; and,
- Construction of settlement ponds will be volume neutral, and all excess material will be used locally to form pond bunds and surrounding landscaping.

Residual Effect Assessment: The granular soil and peat at the Site can be classified as of “Low” importance and the bedrock of “Low” importance.

The overall Site area is extensive while the Proposed Project footprint (8.75ha) is approximately 2.3% of the overall EIAR Study Area of 376.5ha.

The design measures incorporated into the Proposed Project as described above in particular the avoidance of deeper peat areas combined with the ‘low’ importance of the deposits means that the residual effect will be negative, slight, direct, likely, permanent effect on peat, soil, subsoil and bedrock due to disturbance and relocation within the Site.

Significance of Effects: For the reasons outlined above, no significant effects on peat and subsoils will occur as a result of the Proposed Project.

8.5.2.3 Contamination of Soils by Leakages and Spillages of Hydrocarbons or Chemicals (Proposed Project)

Accidental spillage during refuelling of construction plant with petroleum hydrocarbons is a pollution risk at the Proposed Wind Farm and Proposed Grid Connection (Proposed Project) and therefore both are assessed herein.

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.

Pathway: Peat, soil and subsoil and underlying bedrock pore space.

Receptor: Peat, soil, subsoil and bedrock.

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

Proposed Mitigation Measures:

- On-site re-fuelling will be undertaken using a fuel truck 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, oil and chemical 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;
- Safety data sheets for all chemicals used will be kept on-site; 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 4-5**).

Residual Effect Assessment: 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 for the Proposed Project will be negative, imperceptible, direct, short-term, unlikely effect on peat, soil, subsoils and bedrock.

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

8.5.2.4 Erosion of Exposed Subsoils and Peat During Construction of Infrastructure (Proposed Project)

Peat, soils and subsoils are at risk of erosion at both the Proposed Wind Farm and Proposed Grid Connection (Proposed Project) during the construction phase and therefore both are assessed herein.

There is a high likelihood of erosion of peat and spoil during its excavation and during landscaping works at the Proposed Project 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.

Pathway: Vehicle movement, surface water and wind action.

Receptor: Peat, soil and subsoil.

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

Proposed Mitigation Measures:

- 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 storage areas;

- Re-seeding and spreading/planting will also be carried out in these 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; and,
- A full Peat and Spoil Management Plan for the development is included as **Appendix 4-2** of this EIAR.

Residual Effect Assessment: 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 Project site and reseeded and planting will be completed to bind landscaped peat and spoil together. Following implementation of these measures the residual effects will be negative, imperceptible, direct, short-term, likely effect on peat, soils and subsoils by erosion and wind action.

Significance of Effects: For the reasons outlined above, no significant effects on peat, soils, subsoils or bedrock will occur as a result of the Proposed Project.

8.5.2.5 Peat Instability and Failure (Proposed Project)

Peat instability and failure are risks at both the Proposed Wind Farm and Proposed Grid Connection (Proposed Project) during the construction phase and therefore both are assessed herein.

A Peat Stability Risk Assessment was carried out for the main infrastructure elements at the Proposed Project site. This approach takes into account guidelines for geotechnical/peat stability risk assessments as given in PLHRA (2017) and MacCulloch (2005).

Peat instability or failure refers to a significant mass movement of a body of peat that would have an adverse impact on the Proposed Project and the surrounding environment. The potential significant effects of peat failure at the Site may result in:

- Death or injury to site personnel;
- Damage to machinery;
- Damage or loss of infrastructure;
- Drainage disruption by blockage of drainage pathways 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.

However, the findings of the peat stability risk assessment, demonstrate that all Proposed Project infrastructure elements are located in areas of negligible risk as shown in **Figure 8-10** and **Figure 8-11** above.

Notwithstanding the above, 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 on site.

Pathway: Vehicle movement and excavations.

Receptor: Peat and subsoils.

Pre-Mitigation Potential Impact: The findings of the Peat Stability Risk Assessment showed that the Proposed Project site has an acceptable margin of safety, is suitable for the Proposed Project and is considered to be at negligible risk of peat failure. Potential effects on land, soils and geology is therefore considered imperceptible.

Proposed Mitigation Measures:

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

The findings of the peat assessment, which involved analysis of over 344 no. locations, showed that the Proposed Project areas have an acceptable margin of safety and that the site is suitable for the Proposed Project.

The peat stability risk assessment report provides a number of mitigation/control measures to reduce the potential risk of peat failure at each infrastructure location. Sections of access roads to the nearest infrastructure element will be subject to the same mitigation/control measures that apply to the nearest infrastructure element. The required mitigation/control measures are shown below:

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 and detailed designers;
- The construction works on site will be supervised by experienced and qualified personnel;
- Allocate sufficient time for the project to be constructed safely with all peat stability mitigation measures included in the programme;
- Set up, maintain and report findings from monitoring systems, including sightline monitoring;
- Maintain vigilance and awareness through Tool-Box-Talks (TBTs) on peat stability;
- Prevent undercutting of slopes and unsupported excavations;
- Prevent placement of loads/overburden on marginal ground;
- Manage and maintain a robust drainage system. This will be the responsibility of the appointed contractor and their designer;
- Storage of peat material, including temporary and side casting be carried out in the permitted areas only;
- Acrotelm (upper) peat material may be used as landscaping material where topography allows and the detailed designer has assessed the stability risk;
- Uncontrolled placement of peat or loading of peat material must be avoided;
- Water flows within the drainage systems will be controlled. Velocities of flows must be controlled using check dams within drainage systems and the uncontrolled release of water onto slopes can create a landslide risk and must be avoided;
- All construction requiring cut and fill earthworks required a robust monitoring and inspection programme. The details of this inspection programme will depend on the purpose and methodologies of the works and the ground conditions;
- A risk assessment and method statement (RAMS), which considers the potential causes and mitigations of peat instabilities and landslides is required and must be regularly communicated to all site staff. An observational approach by all site staff to the ground conditions and the risks should be promoted, and any changes in the ground or site conditions should be reported and the risk dynamically assessed; and,
- The design and construction teams will develop their own inspection and testing criteria to satisfy and de-risk the possibility of peat landslides.

Please refer to **Appendix 8-1** for details on the safety buffers and stockpile restrictions.

Residual Effect Assessment: A detailed Peat Stability Risk Assessment (GDG, 2025) (**Appendix 8-1**) has been completed for the Proposed Project. The findings of that assessment have demonstrated that there is a negligible risk of peat failure at the Site as a result of the Proposed Project. With the implementation of the control measures outlined above the residual effect is considered negative, imperceptible, direct, permanent, unlikely effect on peat and subsoils.

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

8.5.2.6 Karst Related Ground Instability

Due to the nature of the Proposed Grid Connection route being a long public roads, potential karst features are only likely to present risk at the Proposed Wind Farm site and therefore only the Proposed Wind Farm site is assessed herein.

The findings of the karst risk assessment, indicate that the majority of the Proposed Wind Farm site can be classed as having a low with smaller areas of medium karst risk. In these locations, it is considered that significant karst development is unlikely and unstable ground and significant cavities are not anticipated. Mitigation measures are not envisaged based on the available information.

A portion of the central area of the Proposed Wind Farm site (particularly the areas in the vicinity of T4) have been classed as having high karst risk. In these areas, additional site investigations and mitigation measures will be required. Recommendations for additional ground investigation and potential mitigation measures are considered below.

Typical hazards associated with karst environments include:

- Rapid collapse of doline
- Subsidence of doline
- Cavities and voids
- Variable rock head
- Solutional weathered rock

Notwithstanding the above, the management of karst hazards and appropriate construction practices will be inherent in the construction phase of the Proposed Project to reduce the risk of karst features.

Pathway: Ground collapse and subsidence.

Receptor: Peat, subsoils, bedrock and infrastructure.

Pre-Mitigation Potential Impact: The findings of the karst risk assessment, indicate that the majority of the Proposed Wind Farm site can be classed as having a low to medium karst risk, with smaller localised areas having high risk. Potential effects on land, soils and geology is therefore considered slight to significant pre-mitigation.

Proposed Mitigation Measures:

Mitigation measures for karst related ground instability are shown in Section 6 of the Geotechnical karst Risk Assessment (GDG, 2025) (**Appendix 8-2**). The measures are summarised below.

Mitigation by Avoidance:

All Proposed Project infrastructure has been sited to avoid very high-risk karst features. No karst features have been identified to underly Proposed Project infrastructure locations.

Mitigation by Design:

Detailed Design Phase Investigations:

To reduce the potential risk of encountering unexpected karstic features within the Proposed Wind Farm footprint, additional ground investigations will be carried out during the post consent detailed design phase.

Piled Foundations:

Where small-scale dissolution and voiding are encountered at turbine foundations during detailed ground investigation, one potential mitigation strategy is the use of drilled or grouted piles. The use of piles transfers structural loads to competent rock beneath karst-affected zones. This approach bypasses voids and weak soils, reducing the risk of differential settlement or collapse.

Rock Infill:

This methodology involves ‘choking’ the throat of the sinkhole with coarse granular fill, and progressive backfilling upwards with progressively finer granular fill. All backfill is to be placed in layers 150mm deep and compacted. Soil around the sinkhole is to be excavated to a radius of 3-5m, before being replaced and compacted with or without incorporation of anchored geogrid.

Grouting:

Pressure grouting can be employed to stiffen soil over limestone and prevent its movement into fissures, to fill localised fissures, and to stabilise fractured rock. It is worth noting that the injection of a fluid grout can result in significant losses into adjacent caves before sealing karstic fissures. The detailed designer/contractor shall consider which grouting method would be most appropriate and the potential negative consequences for contamination and pollution of the aquifer.

Binding Layers and Geo-grids:

One of the most effective and widely adopted engineering solutions to mitigate the risks of unacceptable settlement and unexpected collapse at access tracks is the use of bridging layers reinforced with geogrids.

Bridging layers are designed to span across potential voids or weak zones, redistributing loads and preventing localised collapse. When combined with geogrid reinforcement, these layers gain enhanced tensile strength and load-spreading capacity, allowing them to maintain structural integrity even in the event of subsurface failure.

Drainage Control:

Surface and subsurface drainage systems will be designed to prevent water ingress into karst features, reducing the potential for solutional enlargement and subsidence. This includes the installation of sub-drainage systems, the use of impermeable liners or membranes, and pumping and dewatering during construction.

As described in the Water Chapter (Chapter 9), all Proposed Wind Farm surface water drainage outfalls at level spreaders will be placed outside the 30m potential karst feature buffer zones.

Residual Effect Assessment: A detailed Geotechnical Karst Risk Assessment (GDG, 2025) (**Appendix 8-2**) has been completed for the Proposed Project. The findings of that assessment have demonstrated that with application of the appropriate mitigation measures, calculated overall post mitigation karst risk scores range from Low to Medium.

With the implementation of the control measures outlined above the residual effect is considered negative, imperceptible to slight, direct, long term, unlikely effect on ground stability.

Significance of Effects: No significant effects on ground stability will occur.

8.5.2.7 **Turbine Delivery Route Works (Proposed Wind Farm)**

The TDR works only relate to the Proposed Wind Farm element and not the Proposed Grid Connection. Only the Proposed Wind Farm is assessed herein.

Minor earthworks are required for turbine delivery. These include for temporary widening of existing roads and junctions. These TDR works are described in Section 4.4 of the EIAR.

Pathway: Extraction/excavation/landscaping.

Receptor: Soil and subsoil

Potential Pre-Mitigation Impact: Negative, imperceptible, direct, likely, temporary effect on land, soil and subsoil.

Proposed Mitigation Measures:

- All works are minor and localised and cover very small areas;
- These works are distributed over a wide area; and,
- All works are temporary in nature.

Residual Impact: The TDR related earthworks are minor in nature and will be temporary in durations. They are also separated from each other by considerable distances. Residual effects of the Proposed Project are Negative, imperceptible, direct, likely, temporary effect on land, soil and subsoil.

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

8.5.2.8 Biodiversity Management and Enhancement Plan (BMEP)

A Biodiversity Management and Enhancement Plan (BMEP) has been prepared for the Proposed Project and is included as Appendix 6-4 of this EIAR. This plan has been developed to offset the loss of habitats identified within the Proposed Wind Farm site and further enhance the biodiversity of the Proposed Wind Farm and its environs. The following enhancement measures are proposed:

- Development of Bog Woodland/Scrub Communities
- Grassland Enhancement
- Marsh Fritillary Breeding Habitat
- Riparian Vegetation/Replanting
- Fen Habitat Enhancement
- Embankments and Pollinator Nesting Habitats

Pathway: Enhancement measures and targeted revegetation.

Receptor: Site habitats

Pre-Mitigation Potential Impact: Positive, slight, direct, permanent likely effect of BMEP.

Mitigation Measures:

A site-specific monitoring and evaluation programme will be implemented to ensure that the success of the proposed measures remains long-term. It will also assist in situations where the habitat establishment may not have been successful by providing evidence of shortcomings, allowing a revised management plan to be formulated. Monitoring results will be reported by the Project Ecologist within an Annual Environmental Report. Reports detailing the monitoring works carried out, the results obtained and a review of their success, along with any suggestions for amendments to the plan will be prepared. The enhancement plan will be updated and amended where required to improve the efficacy of the enhancement work.

Likely Residual Effect: The likely residual effect of the Proposed Project on Site habitats following the implementation of the BMEP is a moderate, positive, direct, permanent effect on habitats.

8.5.3 Operational Phase - Likely Significant Effects and Mitigation Measures (Proposed Project)

There are very few potential direct impacts envisaged during the operational phase of the Proposed Project. The potential impacts 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.

None of these potential impacts will be significant, as they are of such small scale and also of an intermittent nature.

Mitigation measures for land, soils and geology during the operational phase include the use of aggregate from authorised quarries for use in road and hardstand maintenance. Oil used in transformers (at the substation and within each turbine) and storage of oils in tanks at the substation could leak during the operational phase and impact on ground/peat and subsoils and groundwater or surface water quality.

The substation transformer will be in a concrete bunded area, capable of holding 110% of the stored oil volume. Turbine transformers are located within the turbines, so any leaks would be contained within the turbine. These mitigation measures are considered sufficient to eliminate potential risks to ground/peat/soils and subsoils, and groundwater and surface water quality.

8.5.4

Decommissioning Phase - Likely Significant Effects and Mitigation Measures (Proposed Project)

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, hard standing areas. This will be done by covering 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 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 phase as shown in Section 8.5.2 above.

Some of the impacts will be avoided by leaving elements of the Proposed Project in place where appropriate. The substation will be retained by 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.

8.5.5 Risk of Major Accidents and Disasters

Due to the nature of the Site, *i.e.* soft peat deposits, there is a risk of peat movement occurring. However, due to the generally flat nature of the Site, the risk is low.

A comprehensive Peat Stability Risk Assessment (GDG, 2025) has been undertaken for all Proposed Project infrastructure locations, and it concludes that with the implementation of the proposed control (mitigation) measures. The residual effect of a landslide occurring is determined to be imperceptible/negligible.

Karst bedrock potentially presents a risk at the Proposed Project site. The findings of the Geotechnical Karst Risk assessment, indicate that the majority of the Proposed Wind Farm site can be classed as having a low to medium karst risk. In these locations, it is considered that significant karst development is unlikely and unstable ground and significant cavities are not anticipated. In the higher risk areas, mitigation measures (as detailed in Section 8.5.2.6) can be employed to reduce the risk to low – moderate.

8.5.6 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.

Peat failure has also the potential to affect human health, but this would likely require a catastrophic failure to occur. The residual risk of significant peat slide/failure occurring is determined to be negligible to low following the implementation of the proposed control (mitigation) measures.

8.5.7 Cumulative Effects

The potential for impact between the Proposed Project, and other relevant developments has been carried out with the purpose of identifying what influence the Proposed Project (Proposed Wind Farm and Proposed Grid Connection combined) will have on the surrounding environment when considered cumulatively and in combination with relevant existing permitted or proposed projects and plans in the vicinity of the Site, as set out in Chapter 2 of this EIAR. Please see Section 2.7 of Chapter 2 for cumulative assessment methodology.

8.5.7.1 Construction Phase

The nature of the construction works within the Site mean that the effects on the land, soils and geology environment are restricted to the immediate areas of the construction works. The only cumulative effect of the Proposed Project with respect to the lands, soils and geology will be due to the potential removal and transport of material to a licensed waste facility, where required. The environmental effects of the placement of material within the licenced waste facility will have been previously assessed during the licensing process of this facility. There will be no further cumulative effects on the land, soils and geology environment during the construction phase of the Proposed Project.

8.5.7.2 **Operational Phase**

During the operational phase of the Proposed Project all aspects of the land, soils and geology environment will remain constant, with no alteration of any aspect of this environment. As a result, there will be no cumulative effects due to the Proposed Project.

8.5.7.3 **Decommissioning Phase**

During the decommissioning phase of the Proposed Project, there will be minimal disturbance of soil/subsoil. The underground electrical cabling ducts will be left in-situ (cables removed by re-opening the joint bays used for the installation of the cabling) and turbine foundations will not be removed but covered over with soil/subsoil. These works will be limited in scale and there is no potential for cumulative effects with other nearby developments.

