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 effects of the Proposed Repowering of the Existing Kilgarvan Wind Farm on the land, soil and geological environment.

The Existing Kilgarvan Wind Farm currently comprises 28 no. operational turbines as part of 2 no. phases, Kilgarvan I and Kilgarvan II, as detailed in Chapter 1, Section 1.1.1. The Proposed Repowering of the Existing Kilgarvan Wind Farm (henceforth to be referred to as the Proposed Development) comprises the dismantling and removal of the existing 28 no. operational turbines and the erection of 11 no. larger turbines. The Proposed Development also includes upgrades to the existing site access road network, new site access roads, the extension of an existing onsite borrow pit, temporary construction compounds and underground cabling between the proposed turbines and the existing onsite 110kV substation at Coomagearlahy. The Proposed Development uses as much of the existing infrastructure as possible. The existing 110kV overhead grid connection to the existing Clonkeen 110kV substation will not be altered and will be used for the Proposed Development.

This chapter provides a baseline assessment of the environmental setting of the Proposed Development, as described in Chapter 4, in terms of land, soils and geology and discusses the potential likely significant effects that the construction, operation and decommissioning of the Proposed Development will have. Where required, appropriate mitigation measures to avoid any identified significant effects to land, soils and geology are recommended and the residual effects of the Proposed Development post-mitigation are assessed. This chapter also identifies and assesses any likely cumulative effects which may result from the Proposed Development.

A full description of all elements of the Proposed Development is detailed in Chapter 4 of this EIAR. For the purposed of the EIAR, the various project components are described in Section 1.1.1 in Chapter 1.

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 includes 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 Conor McGettigan.

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

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

8.1.3 Scoping and Consultation

The scope for this assessment has been informed by consultation with statutory consultees, bodies with environmental responsibility and other interested parties as summarised in Section 2.6 of Chapter 2 of the EIAR. Consultation responses relating to the land, soils and geological environment were received from the Geological Survey of Ireland and the Health Services Executive. Details of these scoping responses and actions taken to address them are outlined in Section 2.6.2 of this EIAR.

8.1.4 Relevant Legislation

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

The following legislation has been complied with in the preparation of the land, soils and geology chapter of the EIAR:

- 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;
- The Heritage Act 1995, as amended.

8.1.5 Relevant Guidance

The land, soils and geology chapter of this EIAR was prepared in accordance with the 'EIA Directive' as amended by Directive 2014/52/EU and having regard, where relevant, to guidance contained in the following documents:

- Environmental Protection Agency (2022): *Guidelines on the Information to be contained in Environmental Impact Assessment Reports;*
- Institute of Geologists Ireland (2013): *Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements;*
- National Roads Authority (2008): *Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;*
- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (DoHPLG, 2018); and,
- Guidance on the preparation of the EIA Report (Directive 2011/92/EU as amended by 2014/52/EU), (European Commission 2017).
- Institute of Environmental Management and Assessment (IEMA) (2022): A New Perspective on Land and Soil in Environmental Impact Assessment.
- Land Types for Afforestation (Forest Service, 2016b);
- Forest Protection Guidelines (Forest Service, 2002);
- Forest Operations and Water Protection Guidelines (Coillte, 2013);
- Forestry and Water Quality Guidelines (Forest Service, 2000b); and,
- Forests and Water, Achieving Objectives under Ireland's River Basin Management Plan 2018-2021 (DAFM, 2018).

8.2 Assessment Methodology

8.2.1 Desk Study

A desk study of the Proposed Development site was completed in the Summer of 2022 to collect all relevant geological data for the Proposed Development site and the surrounding area. The desk study was completed to supplement site walkover surveys and site investigations. The desk study information has been checked and updated, where necessary, in February and March 2023.

The desk study involved consultation with the following sources:

- Environmental Protection Agency soils and subsoils mapping (www.epa.ie);
- Geological Survey of Ireland – Geological databases (www.gsi.ie);
- Geological Survey of Ireland – Geological Heritage Site Mapping (www.gsi.ie):
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 21 - Geology of Kerry - Cork (GSI, 2003);
- Geological Survey of Ireland – 1:25,000 Field Mapping Sheets; and,
- Aerial Photography; 1:5000 and 6" base mapping.

8.2.2 Baseline Monitoring and Site Investigations

Detailed walkover surveys and geological mapping of the Proposed Development site was undertaken by HES on 07th July 2022 and 25th January 2023. During these site visits observations were made on near surface geological features, accessible bedrock was mapped and peat probing investigations were conducted at proposed infrastructure locations.

A comprehensive geological dataset has been collected as part of this EIAR. HES also completed a detailed review of the previous planning applications and associated planning files and site investigations prior to completing site investigations for the current application.

Recent site investigations to address the Land, Soils and Geology Section of the EIAR included the following:

- HES completed site walkover surveys and geological mapping of bedrock outcrops at the Proposed Development site on 7th July 2022 and 25th January 2023;
- HES completed a total of 64 no. peat probes at Proposed Development infrastructure locations on 7th July 2022 and 25th January 2023. All peat probes were characterised to Von Post Humification Scale;
- Completion of 466 no. peat probes by MKO and GDG (Gavin and Doherty GeoSolutions) in 2022;
- GDG completed 54 no. shear vane analysis in May and August 2022;
- GDG excavated 13 no. trial pits in August 2022;
- A Peat Stability Risk Assessment (PSRA) was completed for the Proposed Development by GDG (GDG, 2023) (refer to **Appendix 8-1**); and,
- GDG completed a Peat Management Plan for the Proposed Development (GDG, 2023) (**Appendix 4-2**).

Previous to the site investigations completed specifically for the Proposed Development, 3 historic ground investigations have been completed at the Proposed Development site. This data was used to supplement the recent site investigations detailed above. These historic site investigations comprised:

- Completion of 18 no. trial pits at the existing Kilgarvan Phase I turbine and substation locations (Malone O'Regan, 2004);

- Completion of 75 no. trial pits in October and November 2007 at the Kilgarvan Phase II turbine locations (within the townlands of Lettercannon and Inchincoosh) and along the site access roads (Malachy Walsh and Partners (MWP), 2007); and,
- Completion of 27 no. peat probes and 47 no. gouge cores within the Lettercannon Wind Farm in 2008 (MWP, 2008).

In summary, a large geological dataset, comprising of a total of 764 no. site investigation locations (recent and historic), was used in this assessment.

8.2.3 Impact Assessment Methodology

The guideline criteria (EPA, 2022) require that the baseline environment be described in terms of the context, character, significance and sensitivity of the existing environment. The description of the baseline environment is Step 5 of the information which must be included in an EIAR as per the guideline criteria (2022).

Using information from the desk study and data from the site investigations, an assessment of the importance of the soil and geological environment within the study area and Proposed Development site is assessed using the criteria set out in Table 8-1 (NRA, 2008).

Table 8-1 Estimation of Importance of Soil and Geology Criteria (NRA, 2008).

Importance	Criteria	Typical Example
Very High	Attribute has a high quality, significance or value on a regional or national scale. Degree or extent of soil contamination is significant on a national or regional scale. Volume of peat and/or soft organic soil underlying 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.
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.

Importance	Criteria	Typical Example
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 EPA's Guidelines on the Information to be contained in Environmental Impact Assessment Reports (EPA, 2022) states that there are 7 no. steps in the preparation of the EIAR. The initial steps relate to screening, scoping, the consideration of alternatives and the description of the project. Step 5 related to the description of the baseline environment which is presented in Section 8.3 for the land, soils and geological environment. Step 6 relates to the assessment of impacts and is presented in Section 8.5. The guideline criteria for the assessment of effects states that the purpose of an EIAR is to identify, describe and present an assessment of the likely significant effects. The likely effects are described with respect to their quality (positive, neutral or negative), significance (imperceptible to profound), extent (i.e. size of area or number of sites effected), context (is the effect unique or being increasingly experienced), probability (likely or unlikely), duration (momentary to permanent), frequency and reversibility. The descriptors used in this environmental impact assessment are those set out in the EPA (2022) Glossary of effects as shown in Chapter 1 of this EIAR. In addition, the two impact characteristics proximity and probability are described for each impact and these are defined in Table 8-2.

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

Table 8-2: Additional Impact Characteristics.

Impact Characteristic	Degree/ Nature	Description
Proximity	Direct	An impact which occurs within the area of the Proposed Development, as a direct result of the Proposed Development.
	Indirect	An impact which is caused by the interaction of effects, or by off-site developments.
Probability	Unlikely	The effect can reasonably be expected not to occur.
	Likely	The effect can be reasonably expected to occur.

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

Impact Characteristics		Potential Geological and Hydrological Impacts
Quality	Significance	
Negative only	Profound	Widespread permanent impact on:

Impact Characteristics		Potential Geological and Hydrological Impacts
Quality	Significance	
		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.

8.2.4 Limitations and Difficulties Encountered

No specific limitations or difficulties were encountered during the preparation of this Chapter.

8.3 Existing Environment

8.3.1 Site Description and Topography

The Proposed Development site is located approximately 5.5km northeast of the village of Kilgarvan, Co. Kerry and approximately 6km west of Coolea, Co. Cork. The Proposed Development site has a total area of 775 hectares (ha).

The Proposed Development site is located in an upland setting on the western slopes of the Derrynasaggart Mountain Range, Co. Kerry. The Proposed Development site is characterised by mountainous terrain with moderate to steep slopes in places. The land is characterised by abundant protruding ridges of bedrock outcrop, separating localised pockets of peat. Ground elevation contours within the site range from approximately 190 to 500mOD (metres above Ordnance Datum). Within the site, the local topography generally slopes to the south and southwest towards the Roughty River. The site is characterised by areas of coniferous forestry, transitional woodlands scrub and upland blanket bog. The site is drained by several mountain streams which flow to the southwest. These watercourses include the Glanlee River in the east, the Thureehouma stream to the west and several other unnamed tributaries of the Roughty River.

The topography along the main access road, which runs from the N22 to the Proposed Development site entrance, generally slopes to the north. Ground elevations along the main access road range from approximately 140mOD in the vicinity of the N22 to approximately 465mOD at the entrance to the site. This area drains towards the Flesk River via the Coomagearlahy River and the Owgarriv River. This area is characterised by upland blanket bog, coniferous forestry and abundant rock outcrops.

The site is the location of the Existing Kilgarvan Wind Farm, comprising a total of 28 no. operational wind turbines. These existing turbines are supported by a network of access roads, underground cabling, a meteorological mast and the on-site 110kV Coomagearlahy substation. The existing wind farm is connected to the national grid via an overhead line connection to the existing Clonkeen substation located ~4.7km northeast of the site in the vicinity of the N22.

In terms of the Proposed Development infrastructure, a total of 4 no. turbines are located within the townland of Inchee in the east of the site (T1–T4). An additional 4 no. turbines are proposed within the townland of Lettercannon in the southwest of the site (T8-T11). 3 no. turbines are proposed in the townland of Inchincoosh in the northwest (T5-T7).

8.3.2 Land (Land-Take)

Recent aerial photographs, site walkover surveys and Corine land use mapping (2018) have verified the current land use across the Proposed Development site.

Corine land cover maps (2018) show that the Proposed Development site is located predominantly on “peat bogs” with some areas of “transitional woodland scrub” and “coniferous forestry”. Landuse in the wider surrounding area comprises primarily of peat bogs and forestry plantations with agricultural lands located further to the east. A small area of agricultural pastures occurs along the Roughty River to the southwest of the Proposed Development site. A ribbon pattern of rural houses is also located along a local road to the southwest. Historic Corine land cover maps (1990-2018) do not record any significant landcover changes in the area of the Proposed Development.

In terms of the Proposed Development infrastructure, 6 no. turbines (T1, T2, T3, T4, T8 and T11) in the east of the Proposed Development site are mapped by Corine (2018) on peat bogs, with 5 no. turbines (T5, T6, T7, T9 and T10) in the west located in areas of transitional woodland scrub.

Site walkover surveys and the inspection of recent aerial photographs have verified landuse at the Proposed Development site. These surveys confirmed that the site is located in an upland area which is dominated by blanket bog, wet heath and coniferous forestry plantations. As stated above, the Proposed Development site is currently an operational windfarm with 28 no. turbines and all supporting infrastructure.

Meanwhile, the Corine landcover map (2018) records the main access road in the north of the Proposed Development site as being largely located in an areas of "transitional woodland scrub" with a small area of "peat bogs" in the townland of Coomacullen.

8.3.3 Peat/Soils and Subsoils

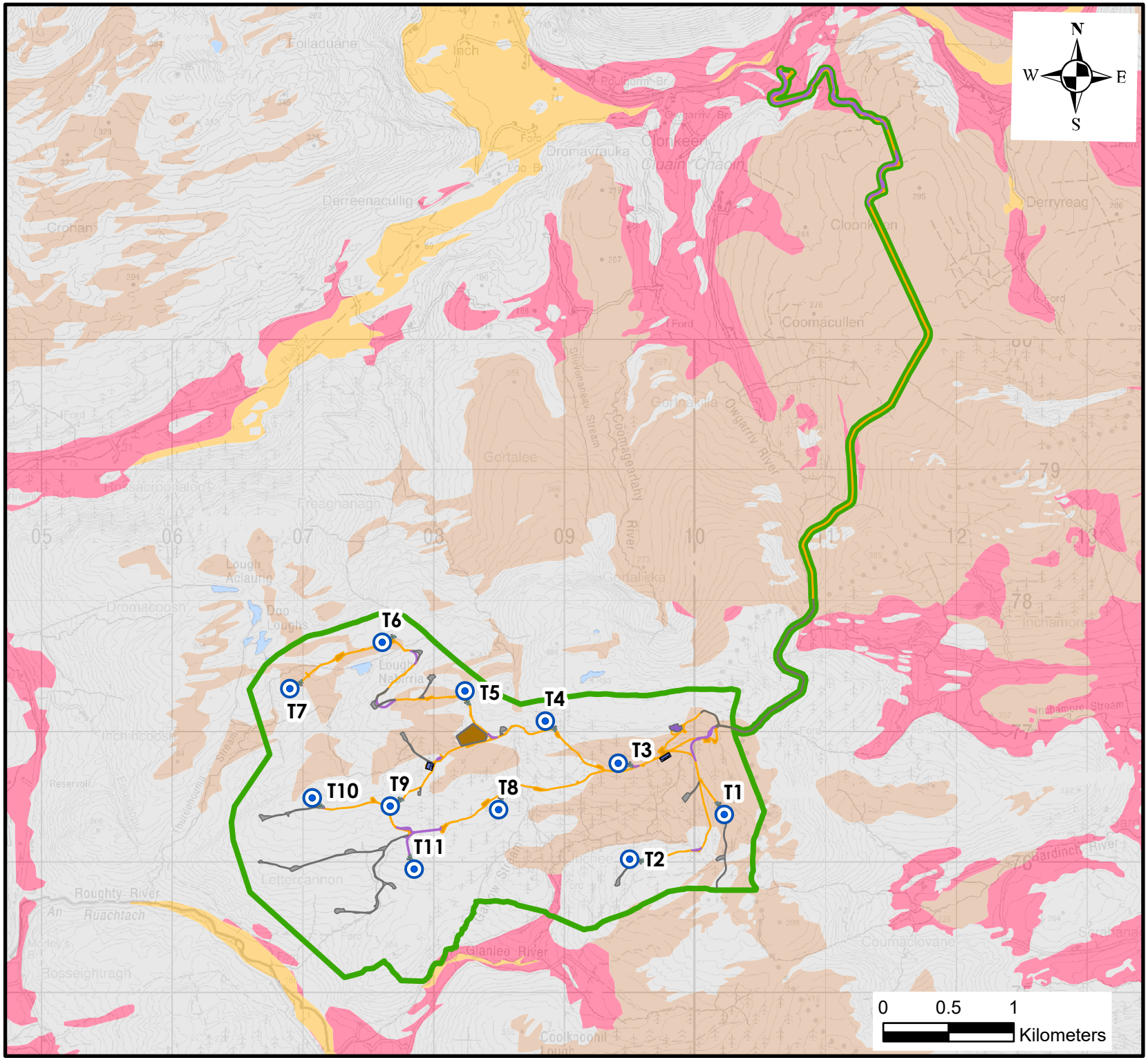
The published soils map (www.epa.ie) for the local area shows that much of the Proposed Development site is overlain by acid shallow, rocky and peaty (AminSRPT) and blanket peat (BktPt). Meanwhile, soils in the north of the main access road, in the vicinity of Clonkeen substation, are mapped by the EPA as acid deep poorly drained mineral soils (AminPD) and acid deep well drained mineral soils (AminDW). In terms of the Proposed Development infrastructure, 4 no. turbines (T1, T3, T6 and T7) are mapped on blanket peat and 7 no. turbines (T2, T4, T5, T8, T9, T10 and T11) are mapped on AminSRPT soils.

Soils in the surrounding lands are predominantly AminSRPT soils with localised pockets of blanket peat, acid shallow well drained mineral soils (AminSW) and acid poorly drains mineral soils with a peaty topsoil (AminPDPT). Mineral alluvium (AlluvMin) is mapped along the Glanlee and Roughty rivers to the south of the Proposed Development site and the Flesk River to the north.

The published subsoils map (www.gsi.ie) for the area shows that much of the Proposed Development site is underlain by bedrock outcrop or subcrop (Rck) and blanket peat (BktPt). The site is dominated by bedrock outcrop with areas of peat between the ridges of outcrop. In terms of Proposed Development infrastructure, 4 no. turbines (T1, T3, T6 and T7) are mapped on blanket peat and 7 no. turbines (T2, T4, T5, T8, T9, T10 and T11) are mapped on bedrock outcrop or subcrop. Meanwhile, subsoils in the north of the Proposed Development site, along the main access road, are mapped predominantly as blanket peat with some Till derived from Devonian sandstones in the north of the route near the existing Clonkeen substation and bedrock outcrop in the vicinity of the site.

Subsoils in the surrounding lands comprise largely of bedrock outcrop and blanket peat with some areas of Till derived from Devonian sandstones (TDSs) to the south and northeast of the site. Alluvium is mapped along the Roughty River to the southwest.

A map of the local subsoil cover is shown below as Figure 8-1.



Legend

- EIAR Site Boundary
- Proposed Turbine Locations
- Proposed Hardstands*
- As Built Coomagearlahy Substation
- Proposed Borrow Pit Location
- Proposed Construction Compounds
- Proposed Road Upgrade Works
- Proposed New Roads and Widening
- Existing Site Roads

Subsoils

- A, Alluvium
- BktPt, Blanket Peat
- Rck, Bedrock outcrop or subcrop
- TDSs, Till derived from Devonian sandstones
- Water

*Proposed hardstands are not visible at this scale

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

Client: Ørsted

Job: Proposed Repowering of the Existing Kilgarvan Wind Farm

Title: Local Subsoils Map

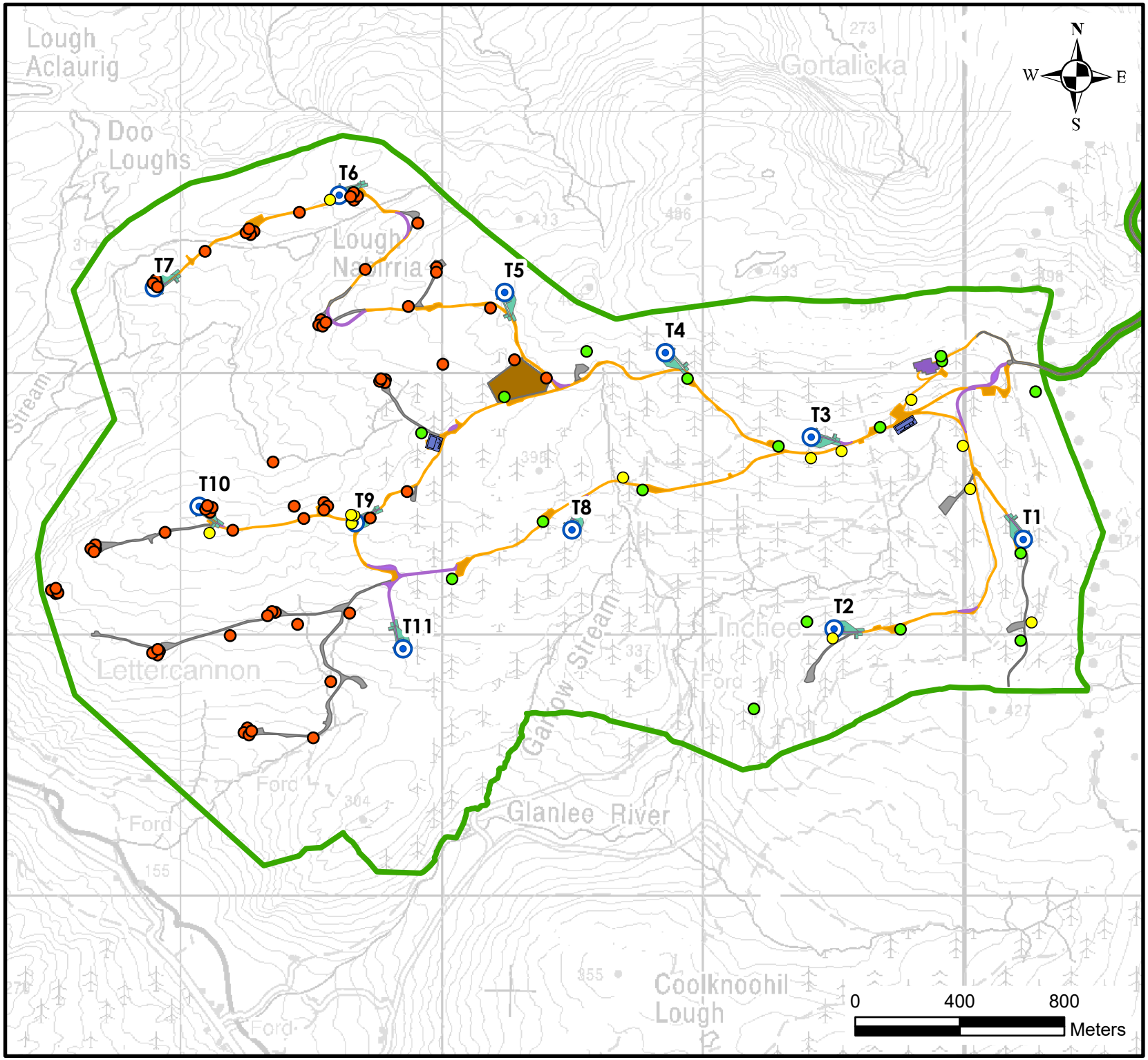
Figure No: 8-1

Drawing No: P1585-0-0424-A4-801-00A

Sheet Size: A4	Project No: P1585-0
Scale: 1:40,000	Drawn By: GA
Date: 10/04/2024	Checked By: MG

The site investigation data on soil and subsoil types within the site is consistent across multiple instances of recent and historic trial pitting and peat probing investigations completed between 2006 and 2022. A total of 764 no. site investigations (peat probes, trial pits, gouge cores and shear vanes) have been completed at the Proposed Development site. This includes the excavation of 106 no. trial pits within the Proposed Development site. In addition, a total of 557 no. peat probes have been completed within the Proposed Development site. Site investigation data has revealed that where present the peat deposits are typically found to be overlying bedrock, although the peat was found to be occasionally underlain by a thin layer of granular material or weathered rock. Where present, these non-peat subsoils comprise of SILTS, SANDS, GRVELS and BOULDERS.

The location of the recent and historic trial pit site investigation locations are shown in Figure 8-2.



Legend

- EIAR Site Boundary
- Proposed Turbine Locations
- Proposed Hardstands
- As Built Coomagearlahy Substation
- Proposed Borrow Pit Location
- Proposed Construction Compounds
- Proposed Road Upgrade Works
- Proposed New Roads and Widening
- Existing Site Roads
- Trial Pit Locations_2005
- Trial Pit Locations_2007
- Trial Pit Locations_2022

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

Client: Ørsted

Job: Proposed Repowering of the Existing Kilgarvan Wind Farm

Title: Trial Pit Locations Map

Figure No: 8-2

Drawing No: P1585-0-0424-A4-802-00A

Sheet Size: A4	Project No: P1585-0
Scale: 1:20,000	Drawn By: GA
Date: 10/04/2024	Checked By: MG

18 no. trial pits were excavated at the Existing Kilgarvan I Wind Farm turbine and substation locations in 2004 (Malone O'Regan, 2004). The total depth of the trial pits ranged from 0.075-4.9m with an average depth of 2.55m. The logged subsoil deposits comprise of PEAT over CLAY or GRAVEL with increasing cobble content with depth. An additional 75 no. trial pits were excavated as part of the site investigations for the Kilgarvan Phase II development (MWP, 2007). The total depth of these trial pits ranged from 0.2-3.7m with an average depth of 1.57m. The logged soil/subsoil profile typically comprised of black PEAT over clayey sandy GRAVEL over SANDSTONE.

13 no. trial pits were excavated by GDG within the site in August 2022. Detailed logs of these trial pits are included as Appendix J to the Peat Stability Risk Assessment attached as **Appendix 8-1**. The total depth of these trial pits ranged from 1.1 to 4m with an average depth of 2.5m. The trial pits generally comprised of peat to a depth of 0.2-2.3m. the peat was found to overlie silts, sands, gravels and occasional large boulders of sandstone.

A total of 530 no. peat probes have recently been completed at the site by HES, MKO and GDG. Peat depth intervals recorded from this recent combined dataset (MKO, GDG, and HES) are shown on the histogram presented as Figure 8-3. From this dataset, peat depths within the site range from 0-6.5m with an average peat depth of 0.79m (n=530, min = 0m, max = 6.5m, mean = 0.73, μ=0.89m (standard deviation)).

According to HES site data (64 no. peat probes) peat depths at the proposed turbine locations range from 0.05 – 2.32m with an average of 0.96m. The peat at the proposed turbine locations was found to overlie bedrock with all peat probes terminating with a hard refusal. Table 8-4 show the peat depths at the proposed turbine locations.

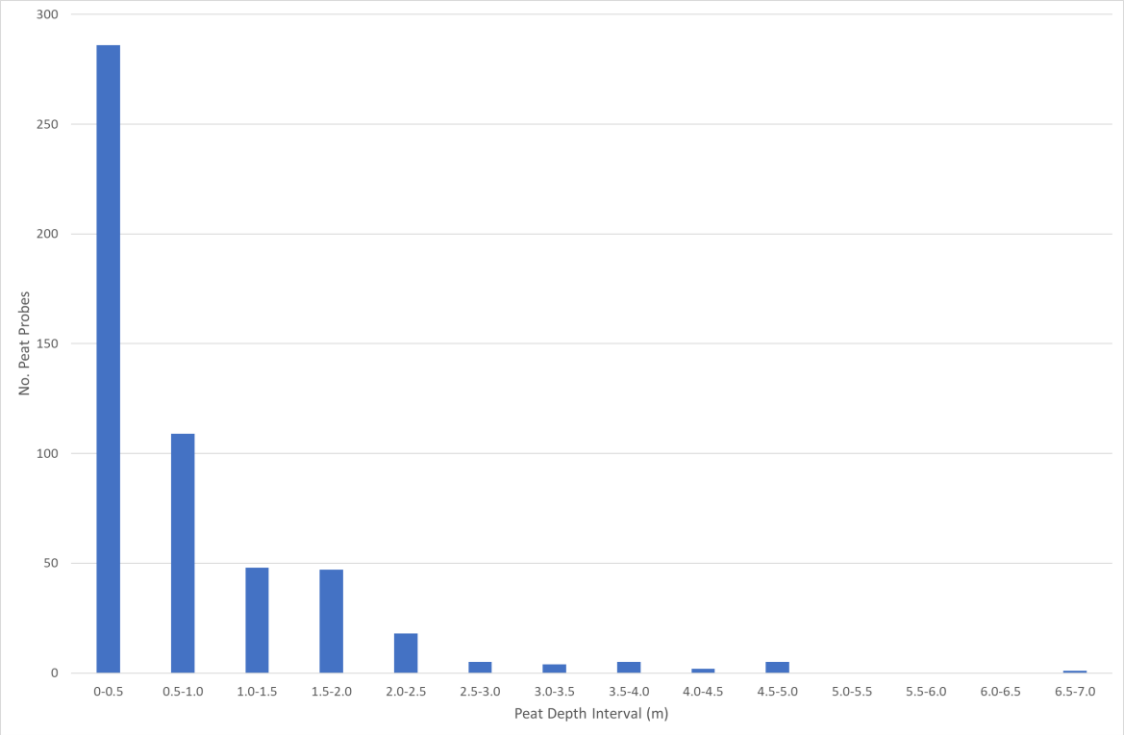


Figure 8-3: Peat Depths at the Proposed Development Site (Combined HES, MKO and GDG Dataset)

Table 8-4: HES Peat Depths at Proposed Turbine Locations

Location ID	HES Peat Depth Range (*T Location & Hardstand*) (m)	HES Peat Depth (m) at Turbine	Summary of Underlying Mineral Subsoil Lithology
T1	0.1 – 0.95	0.5	Peat over hard refusal (bedrock)
T2	1.25 – 2.4	1.25	Peat over hard refusal (bedrock)
T3	0.1 – 0.4	0.1	Peat over hard refusal (bedrock)
T4	0.05 – 2.15	0.05	Peat over hard refusal (bedrock)
T5	0.3 – 0.5	0.3	Peat over hard refusal (bedrock)
T6	0.2 – 0.95	0.95	Peat over hard refusal (bedrock)
T7	1.62 – 2.32	2.32	Peat over hard refusal (bedrock)
T8	0 – 1.93	1.93	Peat over hard refusal (bedrock)
T9	0.5 – 1.25	0.5	Peat over hard refusal (bedrock)
T10	0 – 1.05	1.05	Peat over hard refusal (bedrock)
T11	0.45 – 0.5	0.45	Peat over hard refusal (bedrock)

8.3.4 Bedrock Geology

The GSI map the bedrock underlying the Proposed Development site to comprise of Devonian Old Red Sandstones (DORS) (www.gsi.ie).

The Gun Point Formation underlies the majority of the Proposed Development site, including the majority the south of the main access road. The Gun Point Formation is noted to comprise of green-grey sandstone and purple siltstone. The GSI state that "*in the Derrynasagart Mountains the formation comprises purple and green medium-coarse grained sandstones (locally pebbly) with thin interbedded purple siltstones*" (www.gsi.ie). Meanwhile, the northwest of the Proposed Development site and the northern section of the main access road, are underlain by the Glenfesk Chloritic Sandstone Formation. The GSI state that the main lithologies of the Glenfesk Chloritic Sandstone Formation consist of "*green coloured, mostly medium grained sandstone, conglomerate and pebbly sandstone, together with green and purple siltstone*" (www.gsi.ie).

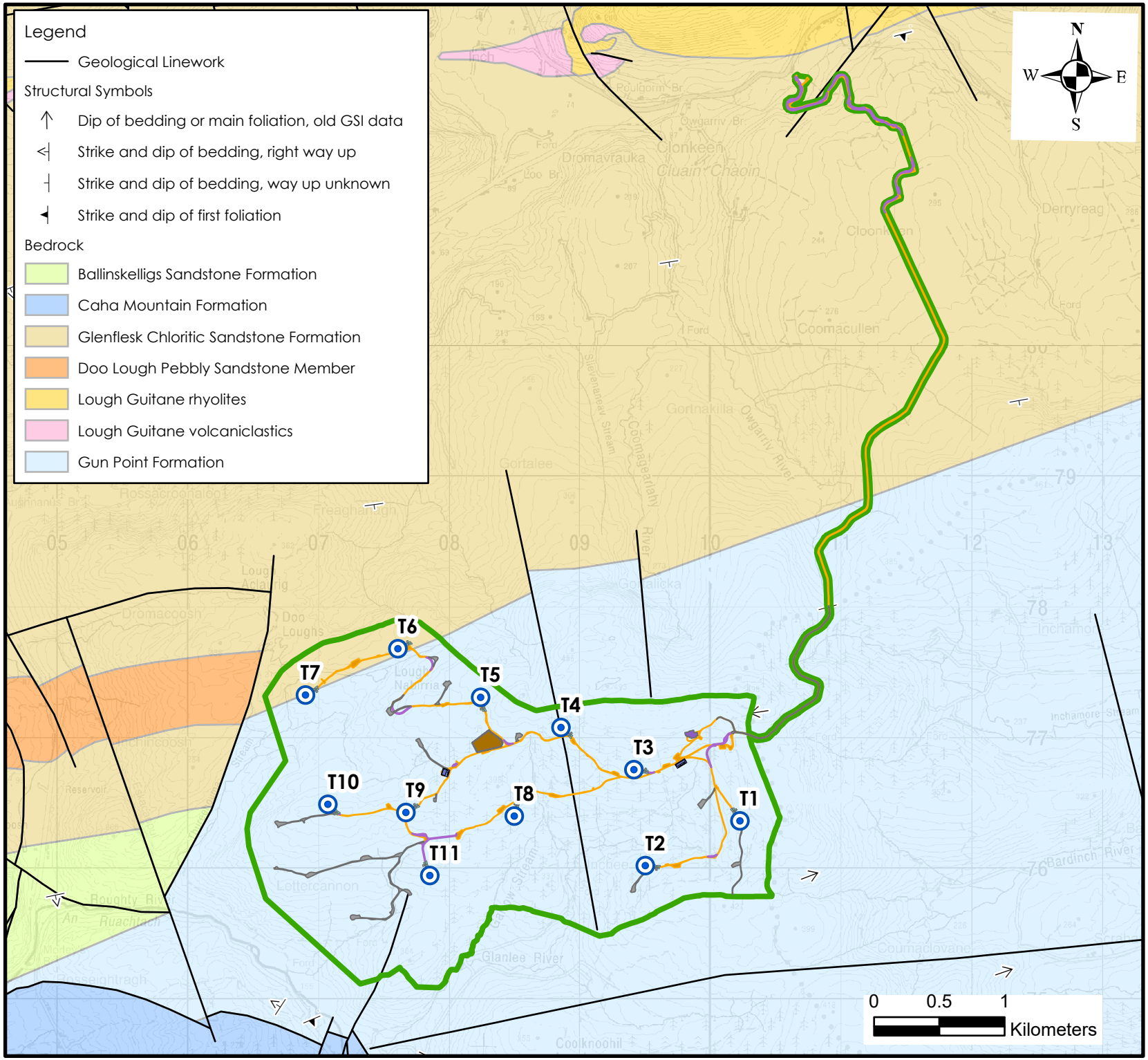
In terms of key Proposed Development infrastructure, a total of 9 no. turbines are underlain by the Gun Point formation while T6 in the townland of Inchincoosh is underlain by the Glenfesk Chloritic Sandstone Formation. T7 is mapped on the contact between both geological formations.

The bedrock geology in this area has been subject to intense compression during the Variscan Orogeny which has resulted in widespread folding and faulting. The GSI map several faults in the area of the Proposed Development site. A large north/northwest – south/southeast orientated fault is mapped in the east and directly underlies the proposed location of T4. A second fault with a northeast to southwest orientation is mapped ~200m southwest of T11. Another fault of similar orientation is also mapped to underlie the north of the main access road in the townland of Clonkeen. The GSI also map several additional faults in the surrounding lands.

The GSI map large areas of bedrock outcrop within the Proposed Development site and in the surrounding lands. Areas of bedrock outcrop are mapped by the GIS in the vicinity of T2, T6 and T11. Site walkover surveys and peat probing investigations have shown that bedrock is exposed and/or close to the surface across much of the site.

Bedrock was encountered during the historic and recent trial pit investigations completed as part of the Kilgarvan Phase I and Phase II wind farm developments. The bedrock encountered during these excavations was described as largely red medium grained sandstone with some blue/green medium grained sandstone. The bedrock outcrops encountered during the recent walkover surveys was recorded as red and green sandstones. These on-site observations correspond to that of the Gun Point Formation and the Glenfesk Chloritic Sandstone Formation as mapped and described by the GSI (www.gsi.ie).

A bedrock geology map of the area is attached as Figure 8-4.



Legend

- EIAR Site Boundary
- Proposed Turbine Locations
- Proposed Hardstands*
- As Built Coomagearlahy Substation
- Proposed Borrow Pit Location
- Proposed Construction Compounds
- Proposed Road Upgrade Works
- Proposed New Roads and Widening
- Existing Site Roads

*Proposed hardstands are not visible at this scale

HYDRO ENVIRONMENTAL SERVICES

22 Lower Main St
Dungarvan
Co.Waterford
Ireland

tel: +353 (0)58 44122
fax: +353 (0)58 44244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie

Client: Ørsted

Job: Proposed Repowering of the Existing Kilgarvan Wind Farm

Title: Local Bedrock Geology Map

Figure No: 8-4

Drawing No: P1585-0-0424-A4-804-00A

Sheet Size: A4	Project No: P1585-0
Scale: 1:40,000	Drawn By: GD
Date: 10/04/2024	Checked By: MG

8.3.5 Geological Resource Importance

The GSI Online Minerals Database accessed via the Public Data Viewer (www.gsi.ie) does not record the presence of any active or historic quarries or pits within the Proposed Development site or in the surrounding lands.

The closest mapped active bedrock quarry is Willian Quarry, located ~12km to the northwest and is hosted in Namurian Undifferentiated shales and sandstones. Meanwhile ~22km to the southeast, Kilmichael Quarry at Coolclevane, is a bedrock quarry mapped within the Gun Point Formation. The products at Kilmichael Quarry are used for manufacturing many sizes of stone for surface dressing chips, asphalt products and fill (www.gsi.ie).

The GSI do not record any mineral localities within the Proposed Development site or in the surrounding lands (www.gsi.ie). The closest mapped mineral locality is located in the townland of Glen, ~4km northwest of the Proposed Development Site, where roofing slate is reported. Meanwhile, copper has been recorded at Cahernacaha, ~6km to the southeast.

The GSI online Aggregate Potential Mapping Database (www.gsi.ie) shows that the crushed rock aggregate potential of the Proposed Development site ranges from Low to Moderate. The bedrock underlying the Proposed Development site could be classified as "Medium" importance. The bedrock could be used on a "sub-economic" local scale for construction purposes. The bedrock at the Proposed Development site has been used previously to facilitate the construction of the Existing Kilgarvan Wind Farm, with an extension of the existing borrow pit present in the townland of Lettercannon.

The Proposed Development site is not located within an area mapped for granular aggregate potential (i.e., potential for gravel reserves). The closest mapped areas of granular aggregate potential are mapped along the Glanlee River and the Roughty River to the south and southwest of the Proposed Development site and along the Flesk river to the north.

The peat deposits overlying the Proposed Development site can be considered to be of "Low" importance due to their largely thin occurrence and given the fact that the peat is not designated in this area. Refer to Table 8-1 for definition of the criteria.

8.3.6 Geological Heritage Sites

There are no geological heritage sites located within the Proposed Development site (www.gsi.ie).

The closest mapped geological heritage area is Morley's Bridge roadcut, located ~1.5km to the west along the R569. This is a County Geological Site (CGS) and may be recommended for designation as a Geological Natural Heritage Area (NHA). Morley's Bridge roadcut is designated as a CGS due to the excellent exposures of the Glenfesk Chloritic Sandstone Formation. The GSI provide the following description of features within this CGS: "*cross-bedded coarse-grained green sandstones and pebbly conglomerates. Clasts are mostly quartz pebbles, with jasper and sandstone clasts. Green mudflake form mudflake breccias. Normal fault with slickensides offsets the succession to the east.*"

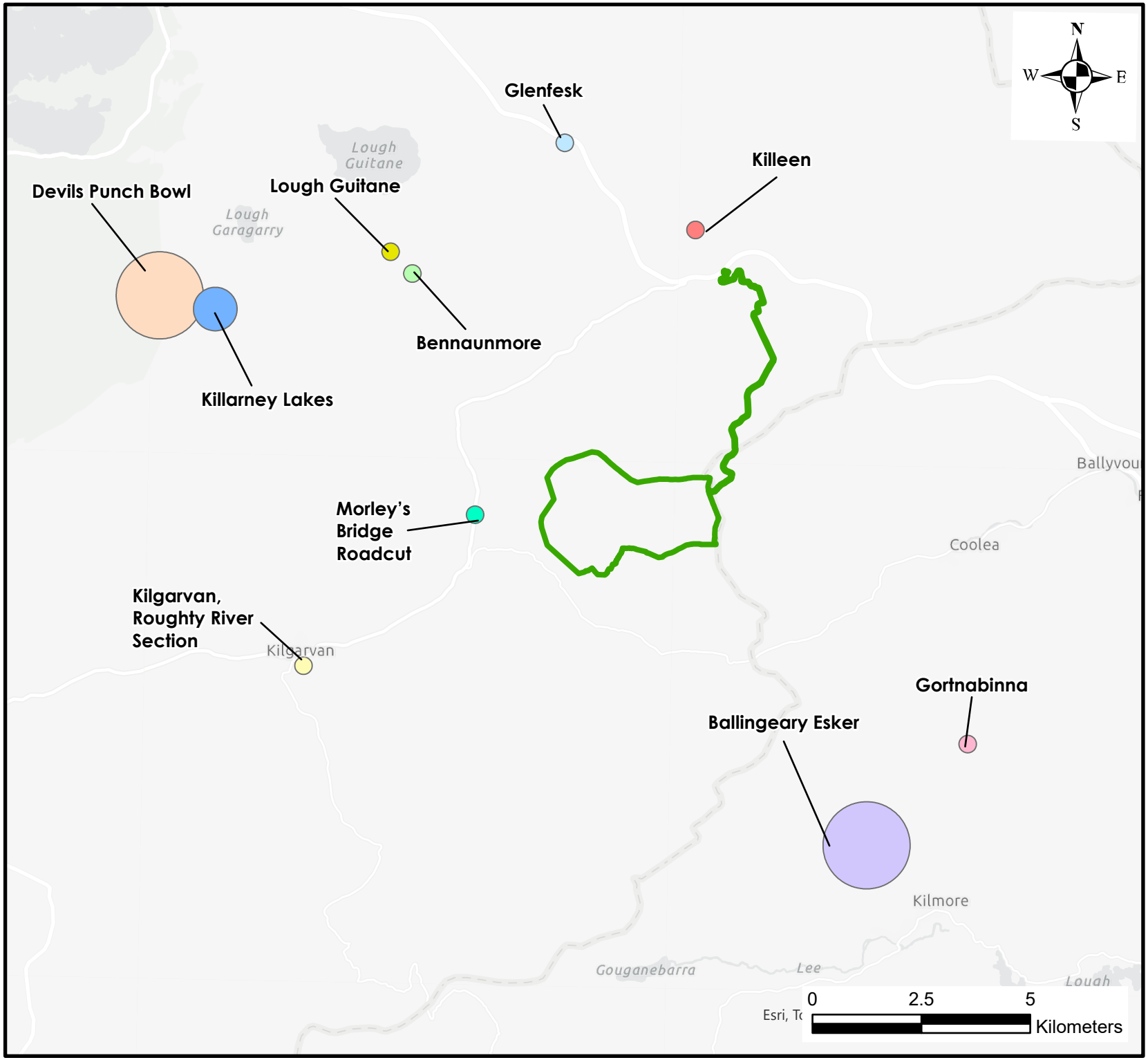
A second CGS site is located at Kilgarvan town, ~4.5km southwest of the Proposed Development site, along the Roughty River. This CGS may be recommended for designation as a Geological NHA and is noted to be of importance due to excellent river and natural inland exposures and a shelf sequence and also due to the mining heritage importance of the area.

Meanwhile, Killeen CGS is located on Coolcurtoga Mountain, ~1km north of Clonkeen substation. This CGS is of geological importance due to the occurrence of rhyolite outcrop. Table 8-5 below presents all geological heritage sites within 10km of the Proposed Development site.

A map of local geological heritage sites is attached as Figure 8-5

Table 8-5: Geological Heritage Sites (www.gsi.ie)

Site Name	IGH Theme	Features	Distance from Proposed Development site
Morley's Bridge Roadcut	IGH 10	Glenfesk Chloritic Sandstone	~1.5km W of Proposed Development site
Kilgarvan, Roughty River Section	IGH8	Shelf Sequence, Mining Heritage Importance	~6km SW of Proposed Development site
Ballingeary Esker	IGH7	Esker	~10km SE of Proposed Development site
Gortnabinna	IGH10	Devonian trace fossils	7.3km SE of Proposed Development site
Killeen	IGH11	Rhyolite	~1km N of Proposed Development site
Glenfesk	IGH10	Devonian chloritic sandstone	~4.5km NW of Proposed Development site
Bennaunmore	IGH11	Rhyolite	~4.5km NW of Proposed Development site
Lough Guitane	IGH10	Devonian sandstone and volcanics	~5.5km NW of Proposed Development site
Killarney Lakes	IGH14	Paternoster Lakes	~7km NW of Proposed Development site
Devils Punch Bowl	IGH7	Cirques	~8km NW of Proposed Development site



Legend

- EIAR Site Boundary

Geological Heritage Sites

- Ballingeary Esker
- Bennaunmore
- Devils Punch Bowl
- Glenfesk
- Gortnabinna
- Kilgarvan, Roughty River section
- Killarney lakes
- Killeen (separated from Bennaunmore by valley)
- Lough Guitane
- Morley's Bridge roadcut

HYDRO ENVIRONMENTAL SERVICES

22 Lower Main St
Dungarvan
Co.Waterford
Ireland

tel: +353 (0)58 44122
fax: +353 (0)58 44244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie

Client: Ørsted

Job: Proposed Repowering of the Existing Kilgarvan Wind Farm

Title: Geological Heritage Sites Map

Figure No: 8-5

Drawing No: P1585-0-0424-A4-805-00A

Sheet Size: A4	Project No: P1585-0
Scale: 1:120,000	Drawn By: GA
Date: 10/04/2024	Checked By: MG

8.3.7 Soil Contamination

There are no known areas of soil contamination within the Proposed Development site. During the site walkovers, no areas of contamination concern were identified. A historic borrow pit associated with the construction of the Existing Kilgarvan Wind Farm is located towards the centre of the site in the townland of Lettercannon. The GSI do not map the presence of any historic quarries or sand and gravel pits within the Proposed Development site (www.gsi.ie).

According to the EPA online mapping (www.epa.ie), there are no licenced waste facilities or dump sites located within the Proposed Development site or its immediate environs. The closest EPA mapped waste locality is Coolcaslagh Transfer Station (W0072-01), operated by Kerry Co. Council, located ~14.5km from the Proposed Development site. Meanwhile, Kenmare Transfer Station (W0086-01) is located ~16.7km to the southwest and Macroom Civic Amenity Site (W0142-01), operated by Cork County Council, is situated ~21.5km to the southeast. The closest EPA mapped IPC facility is the Roughty Valley Co-op Society Limited (IPC Licence No: P0708-02) located approximately 4.5km west of the Proposed Development site.

8.3.8 Peat Stability Assessment

8.3.8.1 Introduction

Gavin and Doherty Geosolutions (GDG) were engaged to undertake a geotechnical and peat stability assessment of the Proposed Development site. A Peat Stability Risk Assessment report (GDG, 2023) is attached as **Appendix 8-1**.

Hydrological, hydrogeological and ecological factors were assessed in the Geotechnical and Peat Stability Assessment Report, and interaction between GDG, HES and MKO were undertaken throughout the iterative design process. 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.

8.3.8.2 Hydrological Considerations

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

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

- Impeded drainage caused by a peat layer overlying an impervious clay or mineral base (hydrological discontinuity, especially an iron pan at the base of the peat deposit);
- A convex slope or a slope with a break of slope at its head (concentration of subsurface flow);
- Proximity to local drainage, either from flushes, pipes or streams (supply of water); and,
- Connectivity between surface drainage and the peat/impervious interface (mechanism for generation of excess pore pressures).

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

8.3.8.3 Peat Slides – Lessons Learned

This peat stability assessment has been undertaken taking into account peat failures that have occurred on peatland sites (such as recent failures at Shass Mountain 2020, Co. Leitrim and Meenbog 2020, Co. Donegal). The lessons learned from both peat slide events have been incorporated into the design of this project and the construction methodologies to be implemented. The Meenbog failure occurred during the construction of a section of floating road on sidelong ground in an area of weak peat. It is important that the existing site drainage is maintained during construction to avoid a similar failure to that on Shass Mountain, which occurred following heavy rainfall, and this is referenced in the Risk Assessments for the turbines/access roads.

8.3.8.4 Peat Stability Desk Study and Investigations

The slope angle within the Proposed Development site ranges from 0º to 61º (GDG, 2023). However, the GSI do not record the occurrence of any historic landslides within the Proposed Development site (www.gsi.ie).

A total of 9 recorded landslides are located within 5km of the EIAR Site Boundary. Many of the landslides located within 5km occurred beside river channels and likely resulted from undermining of steep riverbanks by fluvial erosion. For example, the GSI note the occurrence of a landslide immediately to the south of the site in the townland of Inchee. This historic landslide is located ~1km southeast of T11. This landslide is located in the valley of the Glanlee River where the mapped subsoil type is Till derived from Devonian sandstones. An exception to this is the Fuhiry landslide which occurred ~5km southeast of the Proposed Development site and consisted of a peat slide following heavy rain. This landslide resulted from failure at the interface between peat and gravels.

The GSI Landslide Susceptibility Map (www.gsi.ie) classifies the probability of a landslide occurring. The probability of a landslide at the Proposed Development site ranges from Low to High due to the presence of peat and the mountainous nature of the local area with locally steeply sloping topography. A total of 5 no. proposed turbines are located in areas of moderately high susceptibility. However, site visits and stability analysis completed as part of the Peat Stability Risk Assessment found that these areas are suitable for development (GDG, 2023).

A peat failure was recorded in October 2012 at the site of the Existing Kilgarvan Wind Farm. A forensic report outlining the potential causes, mitigation measures and remediation for this peat failure was detailed in a report entitled “Geotechnical site assessment report for Kilgarvan Windfarm” completed by Applied Ground Engineering Consultants (AGEC, 2012). The failure occurred along one of the existing access roads following a period of excessive rainfall which triggered a translational slide. It is estimated that ~170m^3 of peat failed during this event. According to the AGEC forensic report the landslide was caused by several contributing factors including excessive volume of rainfall over a short period of time, a steep road cutting and the unmanaged release of drainage water onto a peat surface. The failure occurred along the interface between the peat and the underlying mineral soil. The AGEC report recommended the installation of monitoring posts and the installation of a stone buttress at the toe of the failure area. The area of the 2012 failure was inspected by GDG during recent site visits completed in 2022. GDG did not record any evidence of recent instability and based on site data (peat probes and shear vane analysis) the peat appeared to be well drained. A 1.8m high stone buttress has been installed along the access road at the location of the failure.

GDG have completed an analysis of peat sliding at all the main Proposed Development infrastructure locations (proposed turbine, meteorological masts, borrow pit, substation and temporary construction compound locations) across the Proposed Development site as for both the undrained and drained conditions. 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). The assigned probability of instability associated with a given FoS value is described in Table 8-6.

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

Factor of Safety	Slope stability
FoS ≥1.30	Stable and safe
1≤ FoS <1.3	Stable but not safe
FoS <1.0	Unstable

8.3.8.5 PSRA FoS 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 (GDG, 2023).

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

To assess the factor of safety for a peat slide, an undrained (short-term stability) and drained (long-term stability) analysis has been undertaken to determine the stability of the peat slopes on site (GDG,2023).

- 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, 2023) is attached in Appendix 8-1.

Undrained Analysis

The results of the undrained analysis for the peat at the Proposed Development infrastructure locations are presented in Table 8-7. The undrained analysis was undertaken for 2 no. conditions: Condition 1 with no surcharge loading and Condition 2 with a surcharge loading of 10kPa, equivalent to 1m of stockpiled peat. As outlined above the undrained loading condition applies in the short-term during construction and until construction induced pore water pressures dissipate. The FoS has also been calculated semi-automatically in GIS for the entire site (the methodologies are detailed in **Appendix 8-1**) and provides an FoS for other features such a hardstands areas and access roads.

The calculated FoS for Condition 1 is in excess of 1.30 for almost all proposed turbine and construction compound locations, indicating a low risk of peat instability. The calculate FoS ranged from 2.45 to 22.65 at the proposed infrastructure locations. However, based on the semi-automatic FoS calculated in GSI, an isolated small section of the hardstand area for T4 shows an FoS value of between 1 and 1.3. The risk it this area is caused by local factors which are summarised below in Section 8.3.8.6 and discussed in detail in **Appendix 8-1**.

The calculated FoS for Condition 2 was found to be excess of 1.30 for almost all infrastructure locations. indicating a low risk of peat instability. However, based on the GIS calculated FoS, there are some areas along access roads, within or beside the hardstands of T1, T2, T5 and T7 which have an FoS between 1 and 1.3 (*i.e.* stable but not safe). Meanwhile, areas within or beside the hardstand of T4, T6, T8 and T10 have an FoS of <1 (*i.e.* unstable). A small area with an FoS of 1.25 has also been calculated for the T6 location. The risk it this area is caused by local factors which are summarised below Section 8.3.8.6.

Table 8-7: Example Factor of Safety Results (undrained condition) (GDG, 2023)

Turbine No.	Factor of Safety for Load Condition[1]	
	Condition (1)	Condition (2)
T1	11.40	2.26
T2	2.45	1.53
T3	22.65	3.61
T4	4.25	2.06
T5	8.63	1.79
T6	3.44	1.25
T7	5.04	3.08
T8	7.54	3.09
T9	11.02	4.0
T10	5.05	1.87
T11	6.81	2.14
Construction Compound West	10.8	2.74
Construction Compound East	6.95	2.69

Drained Analysis

The results of the drained analysis for the peat at the proposed infrastructure locations are presented in Table 8-8. Similar to the undrained analysis, the drained analysis was done for 2 no. conditions: Condition 1 with no surcharge loading and Condition 2 with a surcharge of 10kPa, equivalent to 1m of stockpiled peat. 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. The FoS for the drained conditions has been calculated for the proposed infrastructure locations. The FoS has also been calculated semi-automatically in GIS for the entire site (the methodologies are detailed in **Appendix 8-1**) and provides an FoS for other features such a hardstands and access roads.

[1] *For the stability analysis two load conditions were examined, namely*

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

The calculated FoS for Condition 1 was in excess of 1.30 at almost every turbine and construction compound locations. The FoS at the proposed infrastructure locations ranged from 2.03 to 18.2, indicating a low risk of peat instability. Meanwhile, based on the GIS calculated FoS, a small section of the hardstand area for T4 and T8 have FoS values between 1 and 1.3 (*i.e.* stable but not safe). The risk it this area is caused by local factors which are summarised below Section 8.3.8.6.

The calculated FoS for Condition 2 was in excess of 1.30 at all proposed turbine locations, indicating a low risk of peat instability. The FoS at the proposed infrastructure locations ranged from 1.97 to 6.95. Meanwhile, a small section of the hardstand area for T4 shows an FoS value between1 and 1.3 (*i.e.* stable but not safe).

Table 8-8: Example Factor of Safety Results (undrained condition) (GDG, 2023)

Turbine No.	Factor of Safety for Load Condition[2]	
	Condition (1)	Condition (2)
T1	9.17	3.86
T2	2.03	2.68
T3	18.2	6.22
T4	3.48	3.58
T5	6.94	3.02
T6	2.61	1.97
T7	4.18	5.42
T8	6.13	5.37
T9	8.93	6.95
T10	4.09	3.21
T11	5.5	3.66
Western Construction Compound	8.71	4.83
Eastern Construction Compound	5.65	4.89

8.3.8.6 PSRA Assessment and Interpretation of FoS Results

Much of the Proposed Development site contains bedrock outcrop which cannot be entirely captured in the FoS model and areas of steep bedrock outcrop may be identified as having a peat instability risk although there is no hazard. For this reason, all locations with an FoS of less than 1.3, in the worst case, undrained and surcharged condition, were ground-truthed to identify true hazards. The result of the ground truthing and the subsequent assessment are summarised in Table 8-9.

Table 8-8: Assessment and Interpretation of Low FoS Results at Proposed Development Locations

Proposed Development Infrastructure	Undrained Surcharged FoS Result	Assessment	Result
T1	Small area of hardstand has an FoS <1.3	Area has variable slope with little to no peat.	Not considered to be a risk
T2	Small area of hardstand has an FoS <1.3	Low FoS results from deep peat (~2m). Construction methodology will involve excavate and replace - area will be stabilised be excavating to bearing strata.	Area is considered to be suitable for construction
T4	Hardstand area has an FoS of <1	Low FoS results are caused by existing steep bedrock and a localised area of deep peat (~2m). The peat is topographically contained within areas of bedrock outcrop and an existing road. The peat will be excavated and removed.	Area is considered to be suitable for construction
T4	Area of hardstand has an FoS <1.3	Low FoS results due to bedrock ridge with steep slopes.	Not considered to be a risk
T6	The area around t6 is sensitive with an FoS of <1.3 at the T location and some areas with an FoS <1 to the west	Low FoS due to local deep peat and steep slopes to the west of the T location. Peat will be excavated and removed, thus eliminating the hazard. Storage of peat will be restricted on the western, downslope side of T6.	Area is considered to be suitable for construction
T7	Small area in the south of the hardstand has an FoS <1.3	Low FoS caused by steep bedrock slopes and a local pocked of ~1m deep peat, located in a topographic hollow. Peat will be excavated and removed, thus eliminating the hazard. Storage of peat will be restricted on the southern, downslope side of T7.	Area is considered to be suitable for construction
T8	Small area in the east of the hardstand has an FoS <1eas	Low FoS caused by local deep peat (~1.9m) and steep bedrock slopes. Peat will be excavated and removed, thus eliminating the hazard.	Area is considered to be suitable for construction

Proposed Development Infrastructure	Undrained Surcharged FoS Result	Assessment	Result
		Storage of peat will be restricted on the eastern, downslope side of T7.	
T10	Small area in the north of hardstand has an FoS <1	Low FoS caused by local peat (~1m) and steep bedrock slopes. Storage of peat should be restricted on the northern slopes of T10.	Area is considered to be suitable for construction
Eastern Construction Compound	Southern section has an FoS <1.3.	Low FoS due to bedrock and engineered fill slope.	Not considered to be a risk.

8.3.8.7 PSRA Conclusions

In summary, an analysis of peat stability was carried out each of the proposed infrastructure locations and the purpose of the analysis was to determine the Factor of Safety (FoS) of the peat slopes.

In summary, the findings of the peat assessment showed that the Proposed Development site has an acceptable margin of safety, is suitable for the Proposed Development and is considered to be at low risk of peat failure. The findings include a series of control (mitigation) measures for construction work in peatlands to ensure that all works adhere to an acceptable standard of safety. These include the application of safety buffer areas and peat storages restriction zones which are detailed in Section 8.5.2.9.

8.3.9 Receptor Sensitivity

This section discusses the sensitivity of the receiving environment in terms of the Proposed Development and identified those sensitive receptors which will be carried forward into the impact assessment. Table 8-10 below presents a screening of all land (land-take), soils and geological receptors identified.

The land (land-take), peat soils and bedrock geological formations at the Proposed Development site will be included into the impact assessment due to their proximal location to the Proposed Development and the potential direct effects that the Proposed Development may have on these receptors. All geological heritage sites have been screened out due to the nature of these sites and their distal location from the Proposed Development. There is no potential for effects to occur.

Table 8-9: Screening of Land, Soils and Geological Receptors

Type	Name	Inclusion in Impact Assessment	Justification
Land (land-take)	Upland peat bog	**Yes**	The Proposed Development site is located in an area of upland peat bog. The construction of the Proposed Development will alter the landcover at the proposed infrastructure locations. Therefore an assessment is required to consider the potential effects of the Proposed Development on the upland peat bogs within the Proposed Development site.
	Coniferous Forestry	**Yes**	The Proposed Development site includes areas of coniferous forestry. Some felling will be required to facilitate the Proposed Development. Therefore an assessment is required to consider the potential effects of the Proposed Development on the coniferous forestry within the Proposed Development Site.
Soils / Subsoils	Peat	**Yes**	Peat is present at all Proposed Development infrastructure locations and excavation and removal of peat will be required to facilitate the Proposed Development. The peat deposits at the Proposed Development Site are generally thin and the peat is degraded in places due to forestry operations or previous construction activity associated with previous wind farm developments. Due to the upland and sloping nature of the Proposed Development Site, there is the potential for a peat slide. Therefore an assessment is required to consider the potential effects of the Proposed Development on the peat deposits within the Proposed Development Site.
Geology	Bedrock Geological Formations	**Yes**	The Gun Point and Glenflesk Chloritic Sandstone formations underlie the Proposed Development Site with widespread bedrock outcrop in the local area. The crushed rock aggregate potential of the Proposed Development Site ranges from Low to Moderate. An assessment is required to consider the potential effects of the Proposed Development on the local bedrock geology.
Geological Heritage Sites	Morley's Bridge Roadcut	No	This site is located ~1.5km to the west of the Proposed Development site and can be screened out due to its distal location from the Proposed Development. The Proposed Development has no potential to impact this site.

Type	Name	Inclusion in Impact Assessment	Justification
	Kilgarvan, Roughty River Section	No	This site is located ~6km to the southwest of the Proposed Development site and can be screened out due to its distal location from the Proposed Development. The Proposed Development has no potential to impact this site.
	Ballingeary Esker	No	This site is located ~10km to the southeast of the Proposed Development site and can be screened out due to its distal location from the Proposed Development. The Proposed Development has no potential to impact this site.
	Gortnabinna	No	This site is located ~7.3km to the southeast of the Proposed Development site and can be screened out due to its distal location from the Proposed Development. The Proposed Development has no potential to impact this site.
	Killeen	No	This site is located ~1km to the north of the Proposed Development site and can be screened out due to its distal location from the Proposed Development. The Proposed Development has no potential to impact this site.
	Glenfesk	No	This site is located ~4.5km to the northwest of the Proposed Development site and can be screened out due to its distal location from the Proposed Development. The Proposed Development has no potential to impact this site.
	Bennaunmore	No	This site is located ~4.5km to the northwest of the Proposed Development site and can be screened out due to its distal location from the Proposed Development. The Proposed Development has no potential to impact this site.
	Lough Guitane	No	This site is located ~5.5km to the northwest of the Proposed Development site and can be screened out due to its distal location from the Proposed Development. The Proposed Development has no potential to impact this site.

Type	Name	Inclusion in Impact Assessment	Justification
	Killarney Lakes	No	This site is located ~7km to the northwest of the Proposed Development site and can be screened out due to its distal location from the Proposed Development. The Proposed Development has no potential to impact this site.
	Devils Punch Bowl	No	This site is located ~8km to the northwest of the Proposed Development site and can be screened out due to its distal location from the Proposed Development. The Proposed Development has no potential to impact this site.

8.4 Characteristics of the Proposed Development

The Proposed Development is defined in Chapter 4. A full description of the Proposed Development is also provided in Chapter 4 of this EIAR.

The Proposed Development will involve removal of peat and in places bedrock for the construction of new internal access roads, the internal cable network, hardstanding emplacement, turbine foundations, crane hardstands, construction compounds and site drainage works. Rock for construction purposes will be sourced from the historic onsite borrow pit which is proposed to be extended as part of the Proposed Development.

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

During turbine construction, peat will be permanently excavated to the substrate to make room for the concrete turbine foundation and a small working area surrounding the foundation footprint. Breaking and excavation of bedrock may be required where it is encountered at shallow depths to achieve the reduced foundation level and level surface required by design. Turbine bases in the range of 27m in diameter are proposed, with detailed foundation design dictated by the local ground conditions and the requirements of the turbine supplier. The plan area of the material to be removed will be dictated by the enabling temporary works design, allowable excavation angle and the mean peat and overburden depths across each turbine location. The design of the turbine base foundations is subject to further ground investigation and the detailed design designer's assessment.

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

The total volume of peat to be excavated during construction is estimated to be 60,080m^3 (refer to Table 8-11 below). These volumes assume a gravity base foundation which is worst case in terms of excavation volumes.

Peat generated during construction can be reused or reinstated across the development. Peat can be reused for landscaping on edges of constructed infrastructure, where topography allows. Peat will also be used in the restoration of the existing hardstand areas which will be decommissioned. A total of 31,710m^3 of peat will be used for landscaping and reinstatement whilst it is estimated that 38,880m^3 of storage will also be available at the location of the extension to the existing borrow pit (refer to Table 8-12). Therefore, the capacity of the placement/reinstatement areas is greater than the volume of material which will be generated by the Proposed Development.

In addition, due to cut and fill requirements, it is estimated that a total of 185,340m^3 of rock will be excavated from Proposed Development locations (turbine locations and along access roads). This volume of rock will be supplemented by 184,190m^3 of rock which will be sourced from the extension to the existing onsite borrow pit. This available rock volume will meet the stone requirements for the construction of the Proposed Development infrastructure and will be reused across the Proposed Development site as general fill (Table 8-13).

Table 8-10: Estimated Peat, Mineral Soil and Rock Excavation Volumes

Infrastructure Element	Excavated Peat Volume (m^3)	Excavated Rock Volume i.e. Cut (m^3)
11 no. turbines and associated hardstands	40,520	99,060
New access roads and upgrades to existing access roads	13,510	86,280
2 no. temporary construction compounds	3,010	-
Borrow Pit	3,040	184,190
Total Volume (m^3)	**60,080**	**369,530**

Table 8-11: Summary of Peat and Spoil Placement/Reinstatement

Location	Peat and Spoil Volume (m^3)
Borrow Pit	38,880
Landscaping at turbine locations	5,320
Landscaping along new access roads	2,000
Landscaping along existing access roads	15,840
Construction compounds	1,170
Existing hardstands for reinstatement	7,380
Total Volume (m^3)	**70,590m^3**

Table 8-12: Summary of Earthworks Stone Requirements

Location	Earthworks Stone Requirements (m^3)
11 no turbines and associated hardstands	164,230
Access Roads	122,550
2 no. construction compounds	22,320
Total Volume (m^3)	**309,100**

8.5 Likely Significant Effects and Associated Mitigation Measures

8.5.1 Do Nothing Scenario

If the Proposed Development was not developed, the site will continue to function as it does at present, with no changes made to the current land-use of a wind farm combined with areas of commercial forestry. The impact of this is considered neutral in the context of the EIAR. If the Proposed Development were not to proceed, the Existing Kilgarvan Wind Farm turbines would eventually be decommissioned as per their existing permissions. The opportunity to capture an even greater part of County Kerry's valuable renewable energy resource would be lost, as would the opportunity to further contribute to meeting Government and EU targets for the production and consumption of electricity from renewable resources and the reduction of greenhouse gas emissions. The opportunity to generate local employment and investment and to diversify the local economy would also be lost.

8.5.2 Construction Phase - Likely Significant Effects and Mitigation Measures

In relation to the Proposed Development, the construction phase encompasses the dismantling and removal of the 28 no. operational wind turbines, the upgrade and extension of the existing site access roads, the extension of the onsite borrow pit, construction of the temporary construction compounds and the 11 no. turbines, hardstands and all associated siteworks.

This section identifies the likely significant effects of the construction phase of the Proposed Development and lists the proposed mitigation measures that will be put in place to eliminate or reduce any potential effects. It should be noted that the main potential effects on the soils and geological environment will occur during the construction stage.

8.5.2.1 Effects of the Removal of the Existing Kilgarvan Wind Farm on Land, Peat/Subsoils

In order to facilitate the construction of the Proposed Development, the existing 28 no. turbines comprising the Existing Kilgarvan Wind Farm will be removed.

This will include the:

- Dismantling and removal of the turbines;
- Existing ancillary infrastructure will be left to regenerate naturally i.e. roads not proposed for upgrade and unused hard standing areas.
- Removal of the electrical cabling between the turbines and the onsite substation.

These activities will not involve the excavation and/or relocation of peat and subsoils within the site. There is no loss of peat or subsoil.

Given the nature of the proposed works there is limited potential for effects on the land, soils and geological environment. The natural revegetation of the existing ancillary infrastructure will have a slight positive long-term effect on the land environment. No short-term effects will occur on the land environment. Meanwhile, a slight negative effect may occur due to the disturbance of peat/subsoil associated with the removal of the electrical cabling.

Pathways: Disturbance of peat and subsoils and natural revegetation of existing ancillary infrastructure.
Receptors: Land, peat and subsoil.

Pre-mitigation Potential Effect: Negative, slight, direct, long-term, likely effect on peat and subsoil due to disturbance. Positive, slight, indirect, long-term, likely effect on land due to natural revegetation.

Mitigation Measures / Impact Assessment:

The Proposed Development layout has been designed to make use of as much of the existing infrastructure as possible, i.e., hardstands, site access roads, the existing substation and overhead grid connection. The integration of the existing wind farm layout and associated infrastructure into the Proposed Development will minimise the disturbance to the peat and subsoils.

The natural revegetation of existing ancillary infrastructure will have a long-term positive effect on the land environment and no specific mitigation measures are required.

Mitigation by Design:

- Where existing electrical onsite cabling is direct buried within peat, this will be left in in-situ, cut, and tied. No excavations will be completed. Where cables have been ducted, the cable will be snipped at both ends and pulled from the ducting. The ducting will remain in situ. Therefore, there will be no disturbance to the peat and subsoils associated with the decommissioning of the existing internal cabling;

Post Mitigation Residual Effect: Due to the nature of the proposed works associated with the removal of the Existing Kilgarvan Wind Farm, there is limited potential for significant effects on the land, soils and geological environment. The natural revegetation of existing ancillary infrastructure areas will have a positive, slight, indirect, long-term effect on the land environment. Meanwhile, due to the nature of the proposed works, in combination with the prescribed mitigation measures, there will be no residual effect on peat and subsoils.

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

8.5.2.2 Effects on Land (Land-Take)

The Proposed Development includes the construction of 11 no. turbines, associated hardstand areas, new access roads, upgrades to the existing road network, 2 no. construction compounds and all associated siteworks. The Proposed Development has a total footprint of 8.2ha.

These works will result in a change in the land environment within these areas. For example, the Proposed Development works will result in the loss of ~8.9ha of coniferous forestry (~5.75ha within the existing wind farm site and ~3.16ha along the main site access roads). The Proposed Development will also result in the loss of upland peat bog as these areas will be replaced by turbine bases, hardstand areas, access roads and other related infrastructure.

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

Furthermore, no effects will occur along the main site access road from the N22 to the site as the only works proposed in this area comprise of upgrades to the existing access road.

Pathways: Excavation and infrastructure construction.

Receptors: Land.

Pre-Mitigation Potential Effect: Negative, slight, direct, permanent, likely effect on land (land-take).

Mitigation Measures / Impact Assessment:

The Proposed Development layout has used the Existing Kilgarvan Wind Farm site layout as much as possible in order to minimise potential effects to land (land-take). This has reduced the area of the site which will be altered from existing forestry and peat bogs to site access roads and/or hardstands.

The loss of ~8.9ha of forestry and ~2.8ha of upland bog will not have a significant impact on soils/land at the Proposed Development site. Following the construction phase these areas of the site will be replaced by hardstand areas. This represents a change in landcover of ~2% of the total Proposed Development site (~775ha). Therefore, the effects of peat bog land loss and commercial forestry land loss within the Proposed Development site is negligible.

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

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

8.5.2.3 Peat and Bedrock Excavation

The excavation of peat and bedrock will be required for all groundworks; including site levelling, the installation of infrastructure and for access road formation and will, therefore, give rise to direct effects on these receptors.

Excavation and removal of peat and bedrock will be required for the following construction works:

- Extension of the existing on-site borrow pit will require the stripping of ~3,040m^3 of peat;
- Construction of the 2 no. temporary construction compounds will require the removal of ~3,010m^3 of peat;
- The upgrade of existing access roads and the construction of new proposed roads will require the removal of ~13,510m^3 of peat;
- Construction of the 11 no. turbine hardstands and bases will require the removal of ~40,520m^3 of peat;
- Excavation of the shallow underground grid cable trench from the turbine locations to the existing onsite 110kV Coomagearlahy substation; and,
- Insertion of the Proposed Development drainage network.

These construction phase activities will result in the permanent removal and relocation of in-situ peat and subsoil at most excavation locations. Estimated volumes of peat and bedrock to be relocated are summarised above in Table 8-11. It is estimated that the total volume of peat and spoil excavated will be 60,080m^3. Meanwhile, it is estimated that 369,5300m^3 of rock will also be excavated during the construction phase. We note that earthworks of this type, scale and magnitude have been granted permission and successfully completed at similar sites around the country.

However, there will be no loss of peat, it will just be relocated within the Proposed Development site. It is proposed to store the excavated material in the borrow pit. Peat materials will also be used for landscaping at the 11 no. turbine locations, along access roads and for the reinstatement of existing hardstands to be decommissioned. Meanwhile, the excavated rock will be used to facilitate the construction of the Proposed Development.

Pathways: Extraction/excavation.

Receptors: Peat and bedrock.

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

Proposed Mitigation Measures by Design:

Mitigation by Avoidance:

The Proposed Development layout has used the Existing Kilgarvan Wind Farm site layout as much as possible in order to minimise the requirement for peat and bedrock excavation.

Mitigation by Design:

- Placement of turbines and associated infrastructure in areas with shallower peat;
- 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;
- The Proposed Development has been designed to avoid sensitive habitats within the application area;
- A minimal volume of peat, subsoil and rock will be excavated and removed to allow for infrastructure works to take place in comparison to the total volume of these materials present on the site due to optimisation of the Proposed Development design;
- In general, excavated peat and spoil will be moved short distances from the point of excavation and will be used for landscaping or stored in the onsite borrow pit; and,
- Construction of settlement ponds will be volume neutral, and all excess material will be used locally to form pond bunds and surrounding landscaping.

Post Mitigation Residual Effect: The peat deposits at the Proposed Development site are classified as being of "Low" importance as the deposits are thin and degraded in places due to the presence of forestry plantations and associated drainage works. Meanwhile, the bedrock geology at the Proposed Development site is classified as being of "Medium" importance and has a Low to Moderate crushed rock aggregate potential.

The impact is the disturbance and relocation of ~60,080m^3 of peat and ~369,530m^3 of bedrock during the construction phase. The design measures incorporated into the Proposed Development as described above in particular the avoidance of deeper peat areas combined with the 'low' importance of the peat deposits and the 'medium' importance of the local bedrock means that the residual effect will be - Negative, slight, direct, likely, permanent effect on peat, subsoils and bedrock due to disturbance and relocation within the Proposed Development site.

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

8.5.2.4 Extension, Excavation and Reinstatement of the Borrow Pit

It is proposed to extend the existing onsite borrow pit which was previously used for the construction of the Existing Kilgarvan Wind Farm. This borrow pit will be reused and extended to facilitate construction of the Proposed Development.

The excavation of ~3,040m^3 of peat and ~184,190m^3 of bedrock will be completed at the existing borrow pit location. Upon removal of the rock from the individual cells within the borrow pits, it is proposed to reinstate the borrow pits using excavated peat and spoil.

Pathway: Extraction/excavation.

Receptor: Peat and bedrock.

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

Proposed Mitigation Measures:

The proposed borrow pit location has been chosen to minimise potential effects on the soils and geological environment. The proposed borrow pit will be an extension to the existing borrow pit which was used to facilitate the construction of the Proposed Development. The existing borrow pit is located in the Gun Point Formation and is overlain by small volumes of peat, therefore reducing the volumes of peat which will require excavation and storage elsewhere in the Proposed Development Site.

The Peat and Spoil Management Plan (GDG, 2023) attached as **Appendix 4-2** sets out the guidelines for the construction and reinstatement of the on-site borrow pit. Upon the removal of the required volumes of material (for the construction of the infrastructure elements at the wind farm) from the borrow pit it is proposed to reinstate the pit using excavated peat. The borrow pit is designed and will be constructed in a way which will allow the excavated peat and spoil to be placed safely, with areas within the borrow pit designated for the storage of excavated peat. Other mitigation measures included in the design of the borrow pit are as follows:

- Excavation works will be undertaken and supervised by an experienced contractor and suitably qualified personnel;
- Rock will be removed by either breaking or blasting and will be determined by confirmatory ground investigations comprising of rotary core drilling;
- The borrow pit will be developed with stable ground inclinations;
- Exposed slopes will be left with irregular faces to promote re-vegetation;
- The stability of the rock faces will be inspected by the Project Geotechnical Engineer upon excavation to ensure stability;
- Rock buttresses will be constructed within the borrow pit to help retain placed peat and spoil. The founding stratum for each buttress will be inspected and approved by the Project Geotechnical Engineer;
- Infilling of peat and spoil should commence at the back of the borrow pit and progress towards the pit entrance.

No other specific mitigation measures are required as the excavation of bedrock to provide material for the construction phase is seen as an acceptable part of the Proposed Development.

Post Mitigation Residual Effect: The bedrock at the Proposed Development site can be classified as of "Medium" importance, while the peat deposits can be classified as being of "Low" importance. The overall Proposed Development site area is extensive (775ha) while the Proposed Development footprint of the borrow pit (2.28ha) is ~0.3% of the overall Proposed Development site area. The effect is the excavation of ~3,040m^3 of peat of spoil during construction and the relocation of bedrock (~184,190m^3) used for the construction of the Proposed Development. The design measures as described above in particular the avoidance of deeper peat areas combined with the 'Medium' and 'Low' importance of the deposits means that the residual effect is considered - Negative, slight, direct, likely, permanent effect on peat, subsoils and bedrock due to disturbance and relocation within the Proposed Development site.

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

8.5.2.5 Proposed Substation Upgrade

The Proposed Development does not include the requirement for a new substation. The Proposed Development will involve the upgrade of the existing onsite 110kV Coomagearlahy substation. All works associated with the upgrade will take place within the footprint of the existing onsite 110kV

Coomagearlahy substation compound. Therefore, there will be no requirement for the excavation of peat and/or bedrock.

However, as with any construction activities, there is the potential for soil contamination from leakages and accidental spillages.

Pathway: Peat and subsoil and underlying bedrock pore space.

Receptor: Peat and underlying subsoil.

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

Proposed Mitigation Measures:

Mitigation measures to prevent soil / subsoil contamination (leaks / spills) are dealt with in Section 8.5.2.6 below.

Post Mitigation Residual Effect: All proposed substation upgrade works are located within the existing substation footprint. Therefore, the potential for the proposed works to affect the soils and geological environment is minimal. With the implementation of the mitigation measures to prevent the contamination of soils/bedrock due to accidental leakages and spills, the residual effect is considered - negative, imperceptible, direct, short-term, unlikely effect on peat and bedrock due to the proposed substation upgrade.

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

8.5.2.6 Contamination of Soil by Leakages and Spillages and Alteration of Peat/Soil Geochemistry

Accidental spillage during refuelling of construction plant with petroleum hydrocarbons is a pollution risk. 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 and underlying bedrock pore space.

Receptor: Peat and bedrock.

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

Proposed Mitigation Measures:

- On-site re-fuelling will be undertaken using a double skinned bowser with spill kits kept on site for accidental leakages or spillages;
- Only designated trained operatives will be authorised to refuel plant on-site;
- Taps, nozzles or valves associated with refuelling equipment will be fitted with a lock system;
- Fuels stored on-site will be minimised. All storage areas will be bunded appropriately for the duration of the construction phase. All bunded areas will be fitted with a storm drainage system and an appropriate oil interceptor. Ancillary equipment such as hoses, pipes will be contained within the bunded area;

- Fuel and oil stores including tanks and drums will be regularly inspected for leaks and signs of damage;
- The electrical control building (at the existing onsite 110kV Coomagearlahy 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; and,
- An emergency response plan for the construction phase to deal with accidental spillages will be contained within the Construction Environmental Management Plan (which is contained in **Appendix 4-3**).

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

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

8.5.2.7 Erosion of Exposed Subsoils and Peat During Construction of Infrastructure

There is a high likelihood of erosion of peat and spoil during its excavation and during landscaping works. The impact source is also associated potential effects on the water environment, and therefore this aspect is further assessed in detail in Chapter 9: Water.

Pathway: Vehicle movement, surface water and wind action.

Receptor: Peat, subsoil and weathered bedrock.

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

Proposed Mitigation Measures:

- Peat removed from the development locations will be reinstated within the Proposed Development site (~24,330m^3 of peat will be used for landscaping at turbine locations, along site roads and at construction compound locations; ~7,880m^3 of peat will be used in the reinstatement of existing hardstand areas to be decommissioned; and,~38,880m^3 of peat will be used to reinstate the borrow pit);
- Where possible, the upper vegetative layer (where still present) 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 shown as **Appendix 4-2**

Post Mitigation Residual Effect: Peat soils and spoil can be eroded by vehicle movements, wind action and by water movement. To prevent this, all excavation works will be completed in accordance with a detailed Peat and Spoil Management Plan, material will be moved the least possible distance, and reseeding and planting will be completed to bind landscaped peat and spoil together. Following

implementation of these measures the residual effected is considered - negative, slight, direct, short-term, likely effect on peat and subsoils by erosion and wind action.

Significance of Effects: For the reasons outlined above, and with the implementation of the proposed mitigation measures, o significant effects on soils, subsoils or bedrock will occur.

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

Tree felling is a component of the proposed works at the Proposed Development Site, with ~8.9ha of felling proposed.

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

Pathway: Vehicle movement, surface water and wind action.

Receptor: Peat, subsoil and weathered bedrock.

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

Proposed Mitigation Measures:

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

No felling works will be completed until a felling licence had been obtained.

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

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

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

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

8.5.2.9 Peat Instability and Failure

A peat stability risk assessment was carried by GDG for the Proposed Development site and the main infrastructure elements associated with the Proposed Development. This approach takes into account guidelines for geotechnical/peat stability risk assessments as given in PLHRA (2017) and MacCulloch (2005). The Peat Stability Risk Assessment report is attached in full as **Appendix 8-1**.

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

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

The findings of the peat assessment showed that the majority of the Proposed Development areas have an acceptable margin of safety and that much of the Proposed Development site is suitable for wind farm development. However, the results of the analysis, combined with site walkover surveys, have allowed for the identification of safety buffers and peat stockpile restriction areas.

Pathway: Vehicle movement and excavations.

Receptor: Peat and subsoils.

Pre-Mitigation Potential Effect: Negative, significant, direct, permanent, likely effect on peat and subsoils. The findings of the peat stability assessment showed that the Proposed Development site has an acceptable margin of safety, is suitable for the Proposed Development and is considered to be at low risk of peat failure. The findings include recommendations and control measures for construction work in peatlands to ensure that all works adhere to an acceptable standard of safety.

Proposed Mitigation Measures:

The following general control measures incorporated into the construction phase of the project will assist in the management of the risks for this site:

- Appointment of experienced and competent contractors;
- The site will be supervised by experienced and qualified personnel;
- Allocate sufficient time for the project (be aware that decreasing the construction time has the potential to increase the risk of initiating a localised peat movement);
- Prevent undercutting of slopes and unsupported excavations;
- Maintain a managed robust drainage system;
- Prevent placement of loads/overburden on marginal ground;
- Implementation of safety buffers around the location of the 2012 landslide and an area of quaking bog to the southwest of T6 as outlined in the Geotechnical and Peat Stability Assessment (GDG, 2023);
- Adhere to the 5 no. peat storage restriction areas detailed in the Geotechnical and Peat Stability Risk Assessment (GDG, 2023);
- Set up, maintain and report findings from monitoring systems as outlined in the Geotechnical and Peat Stability Assessment (GDG, 2023);

- Ensure construction method statements are developed and agreed before commencement of construction and are followed by the contractor;
- Revise and amend the Construction Risk Register as construction progresses to ensure that risks are managed and controlled for the duration of construction; and,
- During construction it is recommended to carry out frequent monitoring, especially after heavy rainfall events or prolonged rainfall.

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

Residual Effect: A detailed Peat Stability Risk Assessment report (GDG, 2023) (**Appendix 8-1**) has been completed for the development proposal. The findings of that assessment have demonstrated that there is a low risk of peat failure at the site as a result of the Proposed Development. 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: For the reasons outlined above, and with the implementation of the proposed mitigation measures, no significant effects on soils and subsoils will occur.

8.5.3 Operational Phase - Likely Significant Effects and Mitigation Measures

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

- Some construction vehicles or plant may be necessary for maintenance of turbines which could result in minor accidental leaks or spills of fuel/oil;
- The transformer in the existing onsite 110kV 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 effects, a small amount of granular material may be required to maintain access tracks during operation which will place intermittent minor demand on local quarries.

8.5.3.1 Site Road Maintenance

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

Pathway: Peat, subsoil and bedrock pore space.

Receptor: Peat, subsoil and bedrock.

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

Proposed Mitigation Measures:

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

Post Mitigation Residual Effect: The use of aggregate for site road maintenance will be minor and infrequent, and all material will be imported to the Proposed Development site from local authorised quarries. The residual effect is considered to be - negative, imperceptible, indirect, short-term, unlikely effect on bedrock.

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

8.5.3.2 Site Vehicle/Plant Use

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

Pathway: Peat, subsoil and bedrock pore space.

Receptor: Peat, subsoil and bedrock.

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

Proposed Mitigation Measures:

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

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

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

8.5.3.3 Use of Oils in Transformers

The transformer in the existing onsite 110kV Coomagearlahy substation and transformers in each turbine are oil cooled. There is potential for spills / leaks of oils from this equipment resulting in contamination of soils and groundwater. Hydrocarbon has a high toxicity to humans, and all flora and fauna, and is persistent in the environment.

Pathway: Peat, subsoil and bedrock pore space.

Receptor: Peat, subsoil and bedrock.

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

Proposed Mitigation Measures:

- All transformers and substation areas will be bunded to 110% of the volume of oil used in each transformer/substation;

- An emergency plan for the operational phase to deal with accidental spillages will be contained in the Environmental Management Plan.

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

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

8.5.4 Decommissioning Phase - Likely Significant Effects and Mitigation Measures

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

During decommissioning, it may be possible to reverse or at least reduce some of the potential effects caused during construction by rehabilitating construction areas such as turbine bases. These areas will be reinstated (top-soiled and reseeded). Other effects such as possible soil compaction and 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 where relevant.

Some of the effects will be avoided by leaving elements of the Proposed Development in place where appropriate. The existing onsite 110kV Coomagearlahy substation is part of the national grid. 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. 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 are envisaged during the decommissioning stage of the Proposed Development.

A Decommissioning Plan is included as **Appendix 4-5**.

8.5.5 Risk of Major Accidents and Disasters

Due to the nature of the Proposed Development site, *i.e.* mountainous terrain with peat covered slopes, there is a risk of a landslide occurring.

A comprehensive Peat Stability Risk Assessment (GDG, 2023) has been undertaken for all Proposed Development infrastructure locations, and it concludes that with the implementation of the proposed control (mitigation) measures. The residual risk of a landslide occurring is determined to be negligible/none.

8.5.6 Assessment of Health Effects

Potential health effects arise mainly through the potential for soil and ground contamination. The Proposed Development 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 are negligible.

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

8.5.7 Potential Cumulative Effects

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

8.5.8 Post Construction Monitoring

None required.