# 8 SOILS AND GEOLOGY

## 8.1 INTRODUCTION

This chapter assesses the impacts of the Development (**Chapter 1: Introduction**) on soils and geology. The Development refers to all elements of the application for the construction of Gortyrahilly Wind Farm (**Chapter 2: Project Description**). Where negative effects are predicted, the chapter identifies appropriate mitigation strategies therein. The assessment considers the potential effects during the following phases of the Development:

- Construction of the Development
- Operation of the Development
- Decommissioning of the Development

Common acronyms used throughout this EIAR can be found in **Appendix 1.2**. This chapter of the EIAR is supported by the Figures provided in **Volume III** and by the appended documents provided in **Volume IV** of this EIAR:

- Site Investigation Report - Stability and Geotechnical Assessment in **Appendix 8.1**
- Photographs in **Appendix 8.2**

A Construction and Environmental Management Plan (CEMP) is appended to the EIAR in **Appendix 2.1**. This document will be a key construction contract document, which will ensure that the mitigation measures, which are considered necessary to protect the environment are implemented. In the event that planning permission is granted for the Development, any condition(s) relating to a CEMP which may be attached by the Board to such a permission, will be implemented in accordance with the requirements of the condition. For the purpose of this application, a summary of the mitigation measures is included in **Appendix 17.1**.

#### *8.1.1.1 Project Description*

The Development (**Figure 8.1a-c**) will consist of the following main components, refer to '**Series 100 Site Layout Plans 6225-PL-100-107'** planning drawings:

- Construction of 14 No. wind turbines with an overall ground to blade tip height ranging from 179m to 185m inclusive. The wind turbines will have a rotor diameter ranging from 149m to 155m inclusive and a hub height ranging from 102.5m to 110.5m inclusive.
- Construction of permanent turbine hardstands and turbine foundations.
- Construction of one temporary construction compound with associated temporary site offices, parking areas and security fencing.
- Installation of one (35-year life cycle) meteorological mast with a height of 110m and a 4m lightning pole on top.
- Development of two on-site borrow pits.

- Construction of new permanent internal site access roads, upgrade of existing internal site access roads and upgrading of the L-34011-20 road (which forms part of the Beara-Breifne Way) and lies within the site, to include passing bays and all associated drainage infrastructure.
- Development of an internal site drainage network and sediment control systems.
- Construction of 1 no. permanent 110 kV electrical substation including 2 no. control buildings with welfare facilities, all associated electrical plant and equipment, security fencing and gates, all associated underground cabling, wastewater holding tank, and all ancillary structures and works.
- All associated underground electrical and communications cabling connecting the wind turbines to the wind farm substation.
- Ancillary forestry felling to facilitate construction of the development.
- All works associated with the permanent connection of the wind farm to the national electricity grid comprising a 110 kV underground cable in permanent cable ducts from the proposed, permanent, on-site substation, in the townland of Gortyrahilly and onto the townlands of Derree, Derreenaculling, Lumnagh Beg, Lumnagh More, Scrahanagown, Bardinch, Milleeny, Inchamore, Derreenaling, Derryreag, Cummeenavrick, Glashacormick, Clydaghroe and Cummeennabuddoge to the existing Ballyvouskill 220 kV Substation in the townland of Caherdowney.
- All associated site development works including berms, landscaping, and soil excavation.
- Improvement of an entrance to an existing private road off the L-7405-0 local road to include localised widening of the road and creation of a splayed entrance to facilitate the delivery of abnormal loads and turbine component deliveries.
- Improvement of an existing site entrance off the L-3402-36 local road to include removal of existing vegetation for visibility splays to facilitate the use of it for the delivery of construction materials to the site.
- Upgrade works on the turbine delivery route to include the following:
  - Construction of a temporary bridge over the Sullane River to allow access to the L-3400-79 from the N22 in Ballyvourney for the duration of the construction works.
  - Localised widening of the L-3405-0 road to a width of 4.5m, from the junction with the L3400-79 road to the junction with the L-7405-0 road.
  - Localised widening of the L-7405-0 road to a width of 4.5m, from the junction with the L-3405-0 to the entrance to an existing private road off the L-7405-0.
  - The construction of a temporary access road off the N22 in the townland of Cummeenavrick to facilitate a 180 degrees turning manoeuvre by the turbine delivery vehicles.

A 10-year planning permission and 35-year operational life from the date of commissioning of the entire wind farm is being sought. This reflects the lifespan of modern-day turbines.

A permanent planning permission is being sought for the Grid Connection and substation as these will become an asset of the national grid under the management of EirGrid and will remain in place upon decommissioning of the wind farm.

#### *8.1.1.2 Grid Connection Route*

The Grid Connection Route description and associated construction methodology is presented in **Appendix 2.4**.

The Gortyrahilly Wind Farm will be connected to the existing Ballyvouskill 220kV substation via underground cabling (UGC). The UGC route is approximately 27.8km in length and traverse in a west to south westerly direction from the existing Ballyvouskill 220kV substation to the Gortyrahilly Wind Farm substation location utilising public local road networks, existing access tracks and private forestry access tracks.

The underground cable route initially begins within the townland of Caherdowney, Co. Cork where from Ballyvouskill 220kV substation compound, the UGC departs the substation on the north western boundary, converging onto a permanent access track to be constructed as part of this development within agricultural lands and traverses on an upward trajectory for approximately 950m prior to entering into forested plantations propertied by Coillte.

The UGC will consist of three 160mm diameter HDPE power cable ducts and two 125mm diameter HDPE communications ducts. These ducts will be installed in an excavated trench c. 600mm wide by 1,315mm deep; variations in the UGC design will be implemented for the adaptation of bridge, service and watercourse crossings. It has been determined that no more than 100m section of trench will be excavated at a time and it is anticipated to take (1 no.) day to complete each 100m excavation, installation of ducting and reinstatement of material. In its entirety, the UGC will have a total of 36 No. Cable Joint Bays (CJBs) and 130 No. identified culvert crossings. 3 No. identified bridge crossings which have insufficient clearance within each structure and will require a Horizontal Directional Drill method to cross. An additional HDD crossing will be required to cross the N22, as well as a 3 No. stream crossing and a further HDD location to traverse Culver 115, giving a total number of HDD crossings of 8 No.

With reference to **Appendix 2.4**:

- Section 1 of the UGC (from Ballyvouskil 220kV substation to N22 Road HDD Crossing), will contain (21 No.) joint bays and 107 No. culvert crossings. This section also has 3 No. watercourse crossings which will require Horizontal Directional Drilling (HDD) as well as the additional HDD pit to cross the N22 for a total of 4 No. HDD locations.
- Section 2 of the UGC (from N22 Road HDD Crossing to Gortyrahilly Windfarm Site location), will contain 15 No. joint bays and 23 No. culvert crossings. This section will have 4 No. watercourse and bridge crossings in total.

Data pertaining to the UGC is as follows:

- Excavation, Installation and Reinstatement Process: Average of one day to complete a 100m section.
- 'Pulling' the Cable: Approximately one day between each joint bay; the jointing of cables taking approximately one week per joint bay location.
- UGC Ducting: 1.3mbGL x 600mm width.
- Joint Bays: Installed approximately every 650mm-850mm along UGC route.
- Joint Bay Dimensions: 2.5m x 6m x 1.75m (pre-cast concrete).
- HDD Launch and Reception Pit Dimensions: 1m x 1mx 2m
- Approximate Depth of Drilling: 1.5mbGL

### Cable Joint Bays

It is estimated that CJBs will be installed c. every 650m - 850m along the UGC route which will be divided into two sections that will be joined together. CJBs will be typically 2.5m x 6m x 1.75m pre-cast concrete structures installed below finished ground level. It is envisioned that CJBs will be located in the non-wheel and weight bearing strip of roadways, however given the narrow profile of local roads this may not always be possible.

### Watercourse Crossings

With reference to the 'Construction Methodology – 110kV Underground Cable Connection Gortyrahilly Wind Farm: Grid Connection Report, Ref no: 05836-R01-04', the Underground Cabling Route (UGC) will include up to 144 No. identified surface water crossings in the form of 130 No. culverts, 7 No. service crossings, 7 No. of bridge / watercourse crossings requiring HDD. These crossings are described in **Appendix 2.4**. An additional HDD location is required for the crossing of the N22, however it does not interfere with a surface waterbody.

Construction of new, or upgrading of existing watercourse crossings will involve similar impacts as described in previous and following sections e.g., excavations and earthworks and entrainment of suspended solids, etc. However, considering the proximity to surface water associated with this type of infrastructure the risk is elevated.

The design of new bridges or watercourse crossings could potentially result in significant changes in flow, erosion and deposition patterns and rates in the watercourse, which can potentially lead to flow being restricted leading to increased risk of flooding locally, or water diverting and increasing the risk of flooding elsewhere, if adequate detail is not given during the design stage. These effects would likely be significant adverse and permanent. However, with reference to the design plan drawings of watercourse crossings (WCs 1-7), presented in **6225-PL-WC1** to **WC7**, if the new bridge is well designed and facilitates or maintains the watercourses' characteristics, including for excessive flow events e.g., 1 in 100-year etc, such adverse effects would likely be temporary.

### Horizontal Directional Drilling

Crossing the 130 no. existing culverts will be implemented using open trenching with either an undercrossing or an overcrossing, depending on the depth of the culvert. All bridges to be crossed have been surveyed with the result of insufficient clearance existing within each structure. Horizontal Directional Drilling (HDD) will be utilized in order to achieve satisfactory clearance along the cable route. Additionally, the remaining watercourse crossings and the crossing of the N22 will require HDD methodology.

Horizontal Direction Drilling (HDD) is a method of drilling under obstacles such as bridges, and water courses in order to install cable ducts below the obstacle. This method is employed where installing the ducts using standard installation methods is not possible. This is a trenchless technology technique, routinely used as an alternative to conventional open cut and cover trenching. There are eight locations along the UGC route which will require HDD, however only 7 No. deal with a watercourse crossing. The necessity of HDD is due to there being insufficient cover and depth in bridges to cross within the bridge deck, the drilling under existing culverts and the crossing of the N22:

- **Stream 1 (ITM: 521700.29, 582994.75)**; JB-07
- **Stream 2 (ITM: 518274.58, 583447.85)**; JB-12
- **Stream 3 (ITM: 517786.76, 583242.64)**; JB-12
- **N22 Crossing (ITM: 513895.4, 580877.4)**; JB-21; **Note, not a watercourse crossing*
- **Bridge 1 (ITM: 513619.0, 577823.5)** Na Doirí Watercourse (W1) JB-28
- **Culvert 115 (ITM: 513833.97, 576685.27)**; JB-29
- **Bridge 2 (ITM: 513977.2, 576135.1)** Barr Duínse Watercourse (W3) JB-30

- **Bridge 3 (ITM: 514221.2, 575350.5)** Droichead Uí Mhathúna Sullane Watercourse (W2) JB-31

HDD will require the excavation of entry and exit pits (1m x 1m x 2m) on either side of the watercourse and the bore path will be drilled to an estimated 1500mm beneath the waterway; additional bridge foundations will be required. The depth of the bore path has been based on locating a suitable clay/silt formation for HDD. It is noted that the required depth may increase subject to geotechnical investigations. Approximate depth of drilling is unknown at time of writing.

#### *8.1.1.3 Turbine Delivery Route*

The Turbine Delivery Route will require road widening, one temporary bridge (ITM: E519298, N577600), and one turning point along the N22 (**Appendix 2.6**). The temporary bridge will have a clear span of 32.0m and entails no instream works (see Drawing No.'s 6225-PL-810 and 6225-PL-811). The chosen location of the bridge provides for the shortest required span of 9m at riverbed level with 20m from top of bank to top of bank. Concrete abutments will be provided to support the deck and will be set back 5m from the river edge (top of bank), this allows for the avoidance of instream works. The estimated excavation amounts for the Turbine Delivery Route, including the turning point, equates to approximately 15,306 $m^2$ (refer to **Table 2.1, Management Plan 4 Appendix 2.1** of the **CEMP).**

It is anticipated that deliveries of turbines to the Wind Farm will be completed over a period of approximately 9 months. When deliveries are completed, the temporary bridge will be dismantled and removed. This portion of the Development and associated construction impacts are similar to those described for the construction of the wind farm infrastructure. Particular attention is required in relation to the design and methodology of the temporary bridge and associated risks working within a surface water buffer zone and mitigation measures laid out in **EIAR Chapter 9: Hydrology and Hydrogeology** will be adhered to.

### 8.1.2 Statement of Authority

Minerex Environmental Ltd. (MEL) is an independent, Irish owned consultancy providing environmental services in the hydrogeological and environmental disciplines. The company was established in 1994 and continues to thrive, providing consultancy to clients in both the public and private sectors. The members of the MEL EIA team involved in this assessment include the following persons:

- Cecil Shine – B.Sc. (Geology), M.Sc (Water & Soil), PGeo, EurGeol – Technical Director and Project Director with >25 years industry experience in the preparation of hydrological and hydrogeological reports.
- Sven Klinkenbergh – B.Sc. (Environmental Science), P.G.Dip. (Environmental Protection) – Associate, Project Manager and EIA Lead Author with c. 10 years industry experience in the preparation of hydrological and hydrogeological reports.
- Jen Caleno – Project Technician with c. 5 years industry experience.
- Dr. Chris Fennel – Project Technician with c. 4 years industry experience.
- Graduate Project Scientist: Lissa Colleen McClung - B.Sc. (Environmental Studies), M.Sc. (Environmental Science).

### 8.1.3 Assessment Structure

In line with the revised EIA Directive and current (draft) EPA guidelines the structure of this Soils and Geology chapter is as follows:

- Assessment Methodology and Significance Criteria
- Description of baseline conditions at the Site
- Identification and assessment of impacts to soils and geology associated with the Development, during the construction, operational and decommissioning phases of the Development
- Mitigation measures to avoid or reduce the impacts identified
- Identification and assessment of residual impact of the Development considering mitigation measures.
- Identification and assessment of cumulative impacts if and where applicable.

## 8.2 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

### 8.2.1 Assessment Methodology

The following calculations and assessments were undertaken in order to evaluate the potential impacts of the Development on the soils, geology and ground stability aspects of the environment at the Site:

- Characterise the topographical, geological and geomorphological regime of the Site from the data acquired through desk study and onsite surveys.
- Undertake preliminary materials budget calculations in terms of volumetric peat / subsoil excavation and removal associated with Development design.
- Consider ground stability issues as a result of the Development, its design and methodology of construction.
- Assess the combined data acquired and evaluate any likely impacts on the soils, geology and ground stability aspects of the environment.

- If impacts are identified, consider measures that would mitigate or reduce the identified impact.
- Present and report these findings in a clear and logical format that complies with EIAR reporting requirements.

### 8.2.2 Relevant Legislation and Guidance

This assessment complies with the Environmental Impact Assessment Directive as amended, which requires Environmental Impact Assessment for certain types of development before development consent is granted. This assessment was undertaken in accordance with the following Irish legislation:

- Planning and Development Act 2000, as amended
- Planning and Development Regulations 2001, as amended
- Wildlife Act 1976, as amended
- EC (Birds and Natural Habitats) Regulations 2011, as amended
- Heritage Act 1995, as amended

The Cork County Development Plan (2022-2028) was also consulted as part of the EIA process.

This assessment has been prepared using, inter alia, the following guidance documents, which take account of the aforementioned legislation and policy:

- BSI (1999) Code of Practice for Site Investigations - BS 5930
- CIRIA (2006) Control of Water Pollution from Linear Construction Projects – Technical Guidance (C649)
- Creighton, R. et al. (2006) Landslides of Ireland
- Department of the Environment, Heritage and Local Government (DEHLG) (2006) Wind Energy Development Guidelines
- Department of Housing, Planning, Community and Local Government (DHPLG) (2017) Interim Guidelines for Planning Authorities on Statutory Plans, Renewable Energy and Climate Change
- Environmental Protection Agency (EPA) (2015) Advice Notes for Preparing Environmental Impact Statements – DRAFT September 2015 (will supersede 2003 version once finalised)
- Environmental Protection Agency (EPA) (2017) Guidelines on the Information to be Contained in Environmental Impact Assessment Reports – DRAFT May 2017 (will supersede 1997 and 2002 versions once finalised)
- Environmental Protection Agency (EPA) (2022) EPA Map Viewer

- Feehan, J. and O'Donovan, G. (1996) The bogs of Ireland
- Geological Survey of Ireland (GSI) (2022) Geological Survey Ireland Spatial Resources
- Gharedaghloo, B. (2018) Characterizing the transport of hydrocarbon contaminants in peat soils and peatlands
- Institute of Geologists of Ireland (IGI) (2002) Geology in Environmental Impact Statements – A guide
- IGI (2013) Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements
- Irish National Seismic Network (INSN) (ND) Recent Earthquakes
- Irish Wind Energy Association (IWEA) (2012) Best Practice Guidelines for the Irish Wind Energy Industry
- Johnston, W. (2022) Physical Landforms of Ireland
- National Roads Authority (NRA) (2008) Guidelines on Procedures for the Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes
- NRA (2008) Environmental Impact Assessment of National Road Schemes – A Practical Guide – Rev 1
- NPWS (2017) Best practice in raised bog restoration in Ireland
- NPWS (2015) National Peatlands Strategy
- RSK (2022) Engineer's Quick Reference Guide for Ground Investigation
- Scottish Forestry Commission (2006) "Guidelines for the Risk Management of Peat Slips on the Construction of Low Volume / Low Cost Roads Over Peat"
- Scottish Government (2017) Peat Landslide Hazard and Risk Assessment: Best Practice Guide for Proposed Electricity Generation Developments
- Scottish National Heritage (SNH) (2013) A Handbook on Environmental Impact Assessment
- Teagasc (2022) Soil Map Viewer


### 8.2.3 Desk Study

MEL undertook desk study assessments of the soils and geology aspects of the Development before and after field investigations. This involved the following components:

- Acquire and compile all available maps of the Development.
- Study and assess the proposed locations of turbines, Site Access Roads relative to available data on site topography and slope gradients.
- Study and assess the proposed locations of turbines, Turbine Delivery Route and an assessment of the Grid Connection Route, connecting the Development to the national grid, substation and associated infrastructure (e.g., potential borrow pit locations, typical

drainage infrastructure) relative to available data on site soils, subsoil and bedrock geology.

- Overlay Ordnance Survey of Ireland (OSI) 1:250,000, 1:50,000 and 1:10,560 (6") maps with AutoCAD plan drawings.
- Overlay Geological Survey of Ireland (GSI) Geology maps (1:100,000) to determine site bedrock geology and the presence of any major faults or other anomalies.
- Overlay Geological Survey of Ireland (GSI) Groundwater Resources (Aquifers), Groundwater Vulnerability, and Groundwater Recharge maps to determine site sensitivity in terms of groundwater.
- Overlay Geological Survey of Ireland (GSI) Landslide Susceptibility maps to determine site landslide susceptibility risk classification.
- Overlay Environmental Protection Agency (EPA) and Teagasc (Agricultural Agriculture & Food Authority) Soils and Subsoil maps (1:50,000) to determine categories of soils and subsoil and indirectly the geochemical origin for the study area.
- Search of the GSI databases and publications in relation to geological extractive resources and mineral localities in the region.
- Search of the GSI landslide database for records of landslide mass movement events at and near the study area.
- Search of the GSI karst database for records of karst features at and near the study area.
- Search of the GSI wells and springs database for records of wells or springs at and near the study area.
- Search of National Parks and Wildlife Service designated sites in the region.

### 8.2.4 Field Work

MEL personnel (Sven Klinkenbergh – Project Manager) carried out field investigations at the site of the Development between January and February 2019, as well as September 2020. These works consisted of the following:

- Bedrock and mineral subsoil outcrop logging and characterisation.
- Confirm if peat is present at or near any proposed Development locations.
- Peat depth probing if peat is present (depth to bedrock and/or competent subsoil).
- Gouge coring if peat is present (peat and subsoil characterisation to BS 5930 and Von Post Humification scale).
- Trial holes in mineral soil to validate desk study findings.
- Boreholes in bedrock to validate to desk study findings.
- Slope measurements at proposed turbine locations to determine slope gradient.
- Recording of GPS co-ordinates for all investigation and monitoring points in the study.

- Digital photography of significant features.

Initial Site walk overs were carried out to assess general ground conditions including topographical characteristics, and to observe the existing Site including visual assessment of the receiving environment in terms of impacts arising from the existing infrastructure and practices at the Site.

### 8.2.5 Evaluation of Potential Effects

#### *8.2.5.1 Sensitivity*

Sensitivity is defined as the potential for a receptor to be significantly affected by a proposed development (EPA, 2017). Potential affects arising by a proposed development in terms of soils and geology will be limited to a localised scale, and therefore in describing the sensitivity of soils and geology it is appropriate to rate such while considering the value of the receiving environment or site attributes.

The following table presents rated categories and criteria for rating site attributes. [1]

**Table 8.1: Criteria for Rating Site Attributes – Soils and Geology Specific**

| Importance | Criteria |
|---|---|
| Extremely High | Attribute has a high quality or value on an international scale. |
| Very High | Attribute has a high quality, significance or value on a regional or national scale. |
| High | Attribute has a high quality, significance or value on a local scale. |
| Medium | Attribute has a medium quality, significance or value on a local scale. |
| Low | Attribute has a low quality, significance or value on a local scale. |

Considering the above categories of rating importance and associated criteria, the following table presents rated sensitivity categories. [2]

**Table 8.2: Criteria for Rating Site Sensitivity – Landscape Character Specific**

| Importance | Criteria |
|---|---|
| High Sensitivity | Key characteristics and features which contribute significantly to the distinctiveness and character of the landscape character type. Designated landscapes e.g. National Parks, Natural Heritage Areas (NHAs) and Special Areas of Conservation (SACs) and landscapes identified as having low capacity to accommodate proposed form of change, that is, sites with attributes of **Very High Importance**. |
| Medium Sensitivity | Other characteristics or features of the landscape that contribute to the character of the landscape locally. Locally valued landscapes which are not designated. |

[1] NRA (2008) Environmental Impact Assessment of National Road Schemes – A Practical Guide – Rev 1
[2] Scottish National Heritage (SNH) (2013) A handbook on environmental impact assessment

| Importance | Criteria |
|---|---|
| | Landscapes identified as having some tolerance of the proposed change subject to design and mitigation etc., that is, sites with attributes of **Medium to High Importance**. |
| Low Sensitivity | Landscape characteristics and features that do not make a significant contribution to landscape character or distinctiveness locally, or which are untypical or uncharacteristic of the landscape type. Landscapes identified as being generally tolerant of the proposed change subject to design and mitigation etc, that is, sites with attributes of **Low Importance**. |

#### *8.2.5.2 Magnitude*

The magnitude of potential impacts arising as a product of the Development are defined in accordance with the criteria provided by the EPA, as presented in the following table. [3]

**Table 8.3: Describing the Magnitude of Impacts**

| Magnitude of Impact | Description |
|---|---|
| Imperceptible | An impact capable of measurement but without noticeable consequences. |
| Slight | An impact that alters the character of the environment without affecting its sensitivities. |
| Moderate | An impact that alters the character of the environment in a manner that is consistent with the existing or emerging trends. |
| Significant | An impact, which by its character, magnitude, duration or intensity alters a sensitive aspect of the environment. |
| Profound | An impact which obliterates all previous sensitive characteristics. |

In terms of soils and geology, magnitude is qualified in line with relevant guidance, as presented in the following table. [4]

**Table 8.4: Qualifying the Magnitude of Impact on Soil and Geological Attributes**

| Magnitude of Impact | Description | Example |
|---|---|---|
| Large Adverse | Results in a loss of attribute. | Removal of the majority (>50%) of geological heritage feature. |
| Moderate Adverse | Results in impact on integrity of attribute or loss of part of attribute. | Removal of part (15-50%) of geological heritage feature. |
| Small Adverse | Results in minor impact on integrity of attribute or loss of small part of attribute. | Removal of small part (<15%) of geological heritage feature. |
| Negligible | Results in an impact on attribute but of insufficient magnitude to affect either use or integrity. | No measurable changes in attributes. |
| Minor Beneficial | Results in minor improvement of attribute quality. | Minor enhancement of geological heritage feature. |

[3] Environmental Protection Agency (EPA) (2017) Guidelines on the information to be contained in Environmental Impact Assessment Reports
[4] NRA (2008) Environmental Impact Assessment of National Road Schemes – A Practical Guide – Rev 1

| Magnitude of Impact | Description | Example |
|---|---|---|
| Moderate Beneficial | Results in moderate improvement of attribute quality. | Moderate enhancement of geological heritage feature. |
| Major Beneficial | Results in major improvement of attribute quality. | Major enhancement of geological heritage feature. |

### *8.2.5.3 Significance Criteria*

Considering the above definitions and rating structures associated with sensitivity, attribute importance, and magnitude of potential impacts, rating of significant environmental impacts is done in accordance with relevant guidance as presented in the **Table 8.5** (NRA, 2008). This matrix qualifies the magnitude of potential effects based on weighting same depending on the importance and/or sensitivity of the receiving environment. In terms of Hydrology and Hydrogeology, the general terms for describing potential effects (Table 8.3: Describing the Magnitude of Impacts) are linked directly with the Development specific terms for qualifying potential impacts (**Table 8.4**: Qualifying the Magnitude of Impact on Geological Attributes) therefore, qualifying terms (**Table 8.5**) are used in describing potential impacts of the Development. This is largely driven by the likely far reaching characteristic of potential effects arising as a product of the Development in terms of Hydrology and Hydrogeology.

**Table 8.5: Sensitivity (Importance of Attribute) & Magnitude of Impact Matrix**

| Sensitivity (Importance of Attribute) | Magnitude of Impact | | | |
|---|---|---|---|---|
| | **Negligible (Imperceptible)** | **Small Adverse (Slight)** | **Moderate Adverse (Moderate)** | **Large Adverse (Significant to Profound)** |
| **Extremely High** | Imperceptible | Significant | Profound | Profound |
| **Very High** | Imperceptible | Significant / Moderate | Profound / Significant | Profound |
| **High** | Imperceptible | Moderate / Slight | Significant / Moderate | Profound / Significant |
| **Medium** | Imperceptible | Slight | Moderate | Significant |
| **Low** | Imperceptible | Imperceptible | Slight | Slight / Moderate |

### *8.2.5.4 Scoping Responses and Consultation*

Scoping responses are set out in **Appendix 1.1: Consultation Responses**.

**Table 8.6: Scoping Responses and Consultation**

| Consultee | Type and Date | Consultee Scoping Response and associated EIAR Chapter | Response |
|---|---|---|---|
| Geological Survey Ireland | Request for Scoping Opinion Ref No. 20/289;<br><br>20.11.2020 | County Geological Sites (CGS), as adopted under the National Heritage Plan, include additional sites that may also be of national importance, but which were not selected as the very best examples for NHA designation. **Our records show that there is an unaudited CGSs in the vicinity of the proposed wind farm development.**<br>**Gortnabinna**, Co. Cork (GR 116250, 71200), under IGH theme: IGH 10, Devonian. The road section at Gortnabinna contains a number of Devonian trace fossils. These well preserved Beaconite-like burrows occur in fluviatile Old Red Sandstone (ORS).<br>With the current plan, there may be potential impacts on the integrity of current CGS envisaged by the proposed development, should these sites not be assessed as constraints. **Ideally, the road section containing the trace fossils should not be damaged or integrity impacted or reduced in any manner due to the proposed development.** However, this is not always possible, and in this situation appropriate mitigation measures should be put in place to minimize or mitigate potential impacts. Where the integrity cannot be preserved we would ask that careful consideration be given in design to accommodating preservation of the road section faces and access to the site during construction to record the exposures to strengthen our knowledge and datasets. We would also ask that the design of any future development considers the use of information panels as appropriate to highlight the significance of the impacted CGS. Please contact Clare Glanville (Clare.Glanville@gsi.ie) for further information and possible mitigation measures if applicable.<br><br>Geological Survey Ireland (GSI) maintains online datasets of bedrock and subsoils geological mapping that is reliable, accessible and meets the requirements of all users including depth to bedrock and physiographic maps. These datasets include depth to bedrock data and subsoil classifications. **We would encourage you to use these data which can be found here, in your future assessments**.<br><br>Geohazards can cause widespread damage to landscapes, wildlife, human property and human life. In Ireland, landslides are the most prevalent of these hazards. **Landslide susceptibility in the area of the proposed wind farm is variable and is classed from Moderately Low / Moderately High to High.** We recommend that geohazards be taken into consideration, | Regarding Gortnabinna site see 8.3.6 Geological Resource Importance<br><br>GSI data has been thoroughly relied upon throughout this assessment.<br><br>Geohazards are considered, see appended SI report.<br><br>The management and reuse of soils and rock at the site is key the process laid out in this EIAR and accompanying documents.<br><br>All documents and figures associated with this assessment will be publicly available.<br><br>The CEMP will include for exposed bedrock etc. as laid out in the consultee response. |

| Consultee | Type and Date | Consultee Scoping Response and associated EIAR Chapter | Response |
|---|---|---|---|
| | | especially when developing areas where these risks are prevalent, and we encourage the use of our data when doing so.<br><br>Geological Survey Ireland is of the view that the sustainable development of our natural resources should be an integral part of all development plans from a national to regional to local level to ensure that the materials required for our society are available when required. Geological Survey Ireland highlights the consideration of mineral resources and potential resources as a material asset which should be explicitly recognised within the environmental assessment process. Geological Survey Ireland provides data, maps, interpretations and advice on matters related to minerals, their use and their development in our Minerals section of the website. The Active Quarries, Mineral Localities and the Aggregate Potential maps are available on our Map Viewer.<br>**In keeping with a sustainable approach we would recommend use of our data and mapping viewers to identify and ensure that natural resources used in the proposed development are sustainably sourced from properly recognised and licensed facilities.**<br><br>Should development go ahead, all other factors considered, Geological Survey Ireland would much appreciate a copy of reports detailing any site investigations carried out. Should any significant bedrock cuttings be created, we would ask that they will be designed to remain visible as rock exposure rather than covered with soil and vegetated, in accordance with safety guidelines and engineering constraints. In areas where natural exposures are few, or deeply weathered, this measure would permit on-going improvement of geological knowledge of the subsurface and could be included as additional sites of the geoheritage dataset, if appropriate. Alternatively, we ask that a digital photographic record of significant new excavations could be provided. Potential visits from Geological Survey Ireland to personally document exposures could also be arranged. | |
| Cork County Council, Planning Department, Ecology Office | Pre-Planning / General Scoping;<br><br>03.02.2021 | Having regard to the site context, the assessment of peat stability will be an important element of these applications. Key concerns from an ecological perspective are:<br>• Potential for impact on sites designated or proposed to be designated for protection of biodiversity;<br>• Potential for impact on habitats of high natural value; and<br>• Potential for impact on protected species. | Stability assessed, see appended SI report. Development footprint/layout avoids areas of increased and/or unacceptable levels of risk.<br><br>Care will be taken in all instances and site specific geohazards are identified |

| Consultee | Type and Date | Consultee Scoping Response and associated EIAR Chapter | Response |
|---|---|---|---|
| | | Assessment of impact on upland habitats including intact peatlands. Per above, it is recommended that development **on intact peatland habitats and upland habitats of high natural value is avoided.**<br><br>Potential for the project to give rise to negative effects on freshwater habitats and having particular regard to potential impacts on Fresh water pearl Mussel and Salmon. To this end, there should be a focus at design stage on providing for an appropriately designed surface water management system which minimises risk of release of contaminants to surface waters and ensures that there is no increase in surface water run-off from the site. Avoidance of disturbance of peat based habitats will greatly assist with this.<br><br>Decommissioning and reinstatement should be considered in detail and shall include opportunities for biodiversity enhancement where possible.<br>Per above comments and based on constraints mapping, it is recommended that development is avoided within areas identified as:<br>• 'blanket bog' in proximity to the developable area associated with turbine 8. | for the purposes of informing the construction methodology and management of materials. |
| Department of Culture, Heritage and the Gaeltacht | Request for Scoping Opinion;<br><br>19.04.2021 | "a thorough geotechnical stability risk and hydrogeological assessment needs to be carried out of areas of relatively deep peat soil, not just for turbine foundations, but also for access roads, borrow pits, drains, etc. There are a number of cases of peat slides during upland wind-farm construction, and the scientific investigations of the causes of these should be taken into account in the EIAR. "<br><br>It is now well established that climate change is likely to have a considerable impact on biodiversity and wildlife, due to droughts, floods, sea level rise, changes in seasonal weather, etc. The impact of CO2 emissions from extensive peat excavation, if this is to be carried out, needs to be fully accounted.<br><br>Impacts from associated works: (a) The likelihood of increases in nutrient loading of the River Sullane from forestry felling should also be assessed6; (b) The effect of haul road widening and bridge upgrade works on protected species (e.g. otter, Kerry slug, Daubenton's and other bat species) should also be assessed; (c) if underground cables are to transport electricity, then river/stream crossings need to be examined, especially if in designated rivers. | Peat/Soil and slope stability risk assessment undertaken, see appended SI report, **Appendix 8.1**.<br><br>Peat / peat soils at the site will be reused, impact to carbon balance likely to be approximately neutral, and imperceptible relative to the carbon balance or carbon buy back period of the development in operation.<br><br>In regard to nutrient loading refer to **Chapter 9 Hydrology and Hydrogeology**. |

| Consultee | Type and Date | Consultee Scoping Response and associated EIAR Chapter | Response |
|---|---|---|---|
| Failte Ireland Environment and Planning Office of Public Works | EIAR Guidelines for the Consideration of Tourism and Tourism Related Projects;<br><br>23.11.2020 | A link between tourism and this prescribed environmental factor, beyond the normal development impacts, is rare, however particular activities or facilities which use geological features may have an impact upon soils and geology, such as mountain biking trails, recreational uses of old quarries etc. Indirect impacts such as material use for extensive landscaping and public realm should also be considered. | Highlighting the public amenities, such as market public walking routes (Beara Brefine Way) in terms of geological sensitivity, the Development is of 'medium significance' or value on a local scale. Furthermore, the magnitude of the associated Development is 'imperceptible; in that it is an impact capable of measurement but without noticeable consequences. **Section 8.2.5.** The Development has the potential to improve this public amenity upon works being completed. |

## 8.3 BASELINE DESCRIPTION

### 8.3.1 Introduction

The Site is situated on Carrigalougha Hill, in the Shehy Mountains in Co. Cork. The Development is 'novel' relative to the Site which is characterised as being rural agricultural land generally, however there are a number of established wind farms in the region including Derragh Wind Farm, 189m to the south east and Grousemount Wind Farm c. 5km west of the Site (**Appendix 2.3 Wind Farms within 20km of Proposed Turbines**).

### 8.3.2 Site Description

The Development, is comprised of 14 No. proposed turbines, one met mast and associated ancillary infrastructure (Turbine Foundations, Site Access Roads, Turbine Hardstands, drainage infrastructure etc.) (**Chapter 2: Project Description**). Each portion of the Site is connected via existing and proposed Site Access Roads which includes for connection to a substation at the Site. The Site is characterised by relatively complex (hilly) topography with associated elevations ranging between c. 230 to 423 metres Above Ordnance Datum (m AOD) (Carrigalougha peak; 423m AOD).

The Development will be connected to the national grid at Ballyvouskill Substation. The Grid Connection Route is approximately 27.8km and comprised of wind farm / forest tracks

(20km), public roads (6.8km) and ESB access track (1km). The Grid Connection cable will be buried, with intermittent cable joint bays and other ancillary infrastructure where required.

### 8.3.3 Land Use

Mapped land use for the Wind Farm, Underground Cable Route and Turbine Delivery Route are presented in Error! Reference source not found.

Consultation with Corine (2018) Land Use maps (EPA) the site is comprised mainly of *Peat Bogs*. The site is otherwise comprised of *Agricultural Areas* and *Forest and semi-natural areas (Coniferous forests* and *Transitional woodland scrub*). Although much of the site is mapped as Peat Bogs, these areas are significantly impacted by agricultural practices including extensive land improvement works involving drainage and excavation and manipulation of natural soil profiles or horizons. For further information on extent of drainage see **Chapter 9: Hydrology and Hydrogeology**.

### 8.3.4 Bedrock Geology

Mapped geology is presented in Error! Reference source not found.**.** There are a number of mapped (GSI, Bedrock 100k[5]) geological formations underlying the site, however each are a variation of Devonian sandstone and siltstone.

- Bird Hill Formation (BH) - Purple siltstone & fine sandstone. Purple-red, fine-grained sandstone and subordinate lightly calcretised purple siltstone. The sandstone is weakly parallel-laminated and contains small-scale cross-lamination. The sandstones are thinly interbedded with siltstones.
- Caha Mountain Formation (CM) - Purple & green sandstone & siltstone. The sandstone bodies show low angle cross stratification and usually have erosive bases, cutting into underlying fine grained material.
- Gortanimill Formation (GM) - Sandstone and siltstone. Medium- to fine-grained green sandstone with some red siltstone.

Ranges of unconfined compressive strength of rock[6]:

- Sandstone is usually within the range of Weak (5-25 MPa) to Medium Strong (25-50 MPa)
- Siltstone is usually within the range of Very Weak (1-5 MPa) to Weak (5-25 MPa).

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[5] Geological Survey of Ireland (GSI) Spatial Resources. Online: https://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228. Accessed: May 2021
[6] Norbury D. (2010) *Soil and Rock Description in Engineering Practice*. Whittles Publishing, Scotland, UK.

Rock strength is strongly correlated to grain size but is affected by other characteristics such as layering and weathering. Sandstone is considered a relatively fine-grained rock, siltstone is comprised of finer constituents than sandstone.

There are numerous faults associated with the underlying geological formations and their interaction. Of note are the boundary faults of CM Formation between the other formations to the north (GN) and south (BH). The northern fault line is thrusting north and the southern boundary thrusting south wards indicating that the CM Formation possesses convergent boundaries where two or more geological formations collide (BH and GN Formations), one side submerging or not significantly impacted (the foot wall) and the other raising and kinking creating topographical peaks and hanging walls. In this instance CM has raised and kinked above BH and GN (indicated by the arrowed fault lines Error! Reference source not found. . These geological features and destructive fault lines give rise to the character of the topography at the Site, particularly areas with steep slopes and/or complex topography densely populated with bedrock outcrops, which correlates with elevation data and contours as presented in **Figure 8.3 (a)**. Bedrock proximal to these fault lines will likely be fractured and/or weathered, as observed as some bedrock outcrop locations.

Consultation with GSI Geotechnical database indicates there is no available data for the underlying formations or in the general area of these Devonian sandstones.

Exposed rock observed possessed examples of layered sandstone with varying degrees of weathering, some significant weathering of significant bedrock outcrop protrusions at or near thrust fault lines discussed above, and as seen in photographs presented in Error! Reference source not found.**.**

Site investigation data, including drill logs are presented in **Appendix 8.1 GWF SI Report - Stability and Geotechnical Assessment.** Summary of bedrock data taken from **Appendix F 3188-A1 GWF SI – Borehole Logs,** is presented in **Table 8.7**. It is noted that the bedrock underlying the Site (Siltstone) is comprised by mainly silt sized particles (0.002 - 0.063mm) (BS 5930).

**Table 8.7: Summary Borehole Data**

| Parameter | (Ref. / Unit) | BH01 | BH02 | BH03 |
|---|---|---|---|---|
| **Geology** | *Drill Log* | Red moderately weak SILTSTONE | Red moderately weak SILTSTONE | Green moderately weak SILTSTONE. |
| **Weathering** | *Drill Log* | Relatively unweathered | Relatively unweathered | Relatively unweathered |

| Parameter | (Ref. / Unit) | BH01 | BH02 | BH03 |
|---|---|---|---|---|
| **UCS Results** | *Kn* | 56.7 | 71.5 | 30.6 |
| **UCS Results** | *MPa* | 12.57 | 15.77 | 6.77 |
| **Rock Strength (UCS MPa)** | *BS EN ISO 14689* | Weak | Weak | Weak |

### 8.3.5 Seismic Activity

The island of Ireland does indeed experience, monitor and record seismic activity, although the magnitude of such occurrences are generally low and do not generally pose as a risk to infrastructure or human health. Seismic activity is monitored on an ongoing basis by the Irish National Seismic Network (INSN). Since 1980, a low number of earthquakes of <M5.0 (Richter magnitude scale (M)) have been detected in the Atlantic close to Ireland. Some relatively recent earthquakes detected include, an M2.4 earthquake which occurred on 01/04/19, the epicentre for which was located within Donegal Bay, and at a depth of 4km, and an M2.0 earthquake which occurred on 29/04/19, the epicentre for which was located approximately midway between Donegal Town and Lough Derg, or approximately 7km south of Barnesmore Bog, and at 16km depth (INSN, ND). Although earthquakes are considered a triggering mechanism for landslides, given the low magnitude experienced in Ireland earthquakes are not considered an important triggering factor.[7]

### 8.3.6 Soils and Subsoils

Consultation with available soil maps (SIS, EPA, Teagasc) indicate that soil types across the Site include Peat and Loamy Drift while large portions of the site are indicated as Rock at surface (**Figure 8.4a)**.

Consultation with available subsoil maps (GSI) indicate that subsoil types across the Site include Bedrock at or near the surface across the majority of the Site, significant deposits of Sandstone Till at lower elevations, with some minor pockets of Blanket Peat at higher elevations and one area of blanket peat at lower elevation along the north-western boundary of the Site (**Figure 8.4b)**.

Observations and data obtained during site surveys coincide with the findings of the desk study as stated in the preceding paragraphs. Peat and Loamy Drift cover the vast majority of the Site with the exception of significant rocky outcrops, particularly at higher elevations.

[7] Creighton, R., Doyle, A., Farrell, E. R., Fealy, R., Gavin, K., Henry, T., Johnston, T., Long, M., McKeown, C., Pellicer, X., Verbruggen, K. (2006) "Landslides in Ireland" *Geological Survey Ireland: Irish Landslides Working Group.*

Furthermore, many minor rocky outcrops were also observed across the Site, particularly at higher elevations. Thin peat and exposed rock were observed at numerous existing cut and fill locations along the existing Site Access Roads and Turbine Hardstands associated with agricultural and forestry practices in the area **(**Error! Reference source not found. **GWF Photographs).**

Site investigation data, including Peat depths, trial pit logs and photographs are presented in the SI Report in **Appendix 8.1**. Summary of peat depths (refer to **Appendix A**) and subsoil particle size distribution (PSD) data (refer to **Appendix G**) are presented in **Table 8.8** and **Table 8.9,** respectively.

**Table 8.8: Reported Subsoil Description (Appendix G 3188-A1 GWF SI- Subsoils Lab Certs).**

| Sample ID | Reported Description (PSD) |
|---|---|
| **TP08-A1 (SS1)** | Silty / clayey sandy GRAVEL |
| **TP13-A1 (SS1)** | Silty / clayey sandy GRAVEL |
| **TP24-A1 (SS1)** | Silty / clayey very sandy GRAVEL |
| **TP30-A1 (SS1)** | Silty / clayey clayey very sandy GRAVEL |

### *8.3.6.1 Peat Depth*

The results of the Peat Depth Probing and Gouge Coring surveys are presented in The SI Report of **Appendix 8.1** as well as **Appendix A** and **Appendix B**.

Peat depths at survey points 378 No. range from 0.00m to <3.50m. Peat depths were generally shallow, particularly at higher elevations. Isolated minor pockets of deeper peat are observed at some locations, particularly within troughs in areas of complex topography.

Peat depths have been mapped by category (**Table 8.9**) and presented in **Appendix A** of **Appendix 8.1.** Certain peat depths are associated with particular hazards and constraining characteristics in terms of infrastructure construction methodology. Peat depth of 2.0m or greater is considered '*deep'* or '*deeper'* peat, and in extensive areas of peat which is >2.0m depth excavation and construction activities become greatly more complicated and present greater risk. In areas with peat depth >5.0m, even if topography is flat and landslide risk is low, a turbine foundation in such an area would likely be piled rather than excavating to competent ground.

**Table 8.9: Peat Depth Distribution by Peat Depth Category (Appendix A-1 to A-5: 3188-A1 GWF SI - Peat Depth (Appendix 8.1))**

| Peat Depth Category | No. | | % |
|---|---|---|---|
| A – Rock (0.00-0.01m) | 84 | | 22% |
| B – Very Shallow (0.01-0.5m) | 226 | | 60% |
| C – Shallow (0.5-2.0m) | 54 | | 14% |
| D – Moderately Deep (2.0-3.5m) | 12 | | 3% |
| E – Deep (3.5-5.0m) | 0 | | 0% |
| F – Very Deep (>5.0m) | 0 | | 0% |
| *Total* | *376* | | |

### 8.3.7 Geological Resource Importance

Consultation with available maps (GSI) indicates that there is one recorded 'Geoheritage' site located on the southern boundary of the Site:

- Geoheritage Site Name: Gortnabinna. Theme: IGH10 (Devonian). Audited: No. Description: Road section. Coordinates (ITM): 516218.22, 571262.51. This feature is adjacent to a public road, on the boundary of the Site, and is characterised by a shear slope / exposed bedrock. This location will not be impacted by the Development footprint. The Grid Connection Route does not pass this location.
- The GSI database does not indicate Mineral Localities or Quarries within the site. Mapped (GSI) Mineral Locality features in proximity to the site include trials for copper (1911) approximately 1km south-west of the Site.

### 8.3.8 Slope Stability

Peat, subsoil and slope stability assessments for the site including the Wind Farm, Turbine Delivery Route and Underground Cable Route are presented in **Figures 8.5 (a - c) Landslide Risk and Events**. Geo-Hazards in relation to the Wind Farm Development are detailed in **Appendix 8.1** and presented in **Appendix 8.1 - Appendix H (a - c).** Conclusions are summarised as follows:

**Peat Stability**

Conclusions made here are drawn with reference to Error! Reference source not found.**, Appendix A and Appendix I**. For further information and context in regard to methodology and definitions, refer to **Section 2** of **Appendix 8.1**.

Peat depth across the site is generally shallow with the exception of minor isolated pockets of deeper peat delineated by shallow subsoils and/or bedrock at or near the surface (**Appendix A**). There was no deep or very deep peat observed at the site. Considering this, there remains a residual risk at the site, it is also important to distinguish between types of landslide, the material in question and associated receptor. With reference to **Appendix 8.1**, the risk of significant peat landslide events occurring at the Site is low given the nature, namely depth of peat at the site. However, the Site also possesses a degree of elevated risk in terms of subsoil stability at the Site. Subsoil, or till landslide events are generally characterised as relatively isolated, see **Plate 8.1** below, in comparison to the fluid nature of peat landslides. Nonetheless, a significant movement of subsoils at the Site, if intercepted by the downgradient surface water network at the Site can have similarly devastating consequences to that of a significant peat landslide.

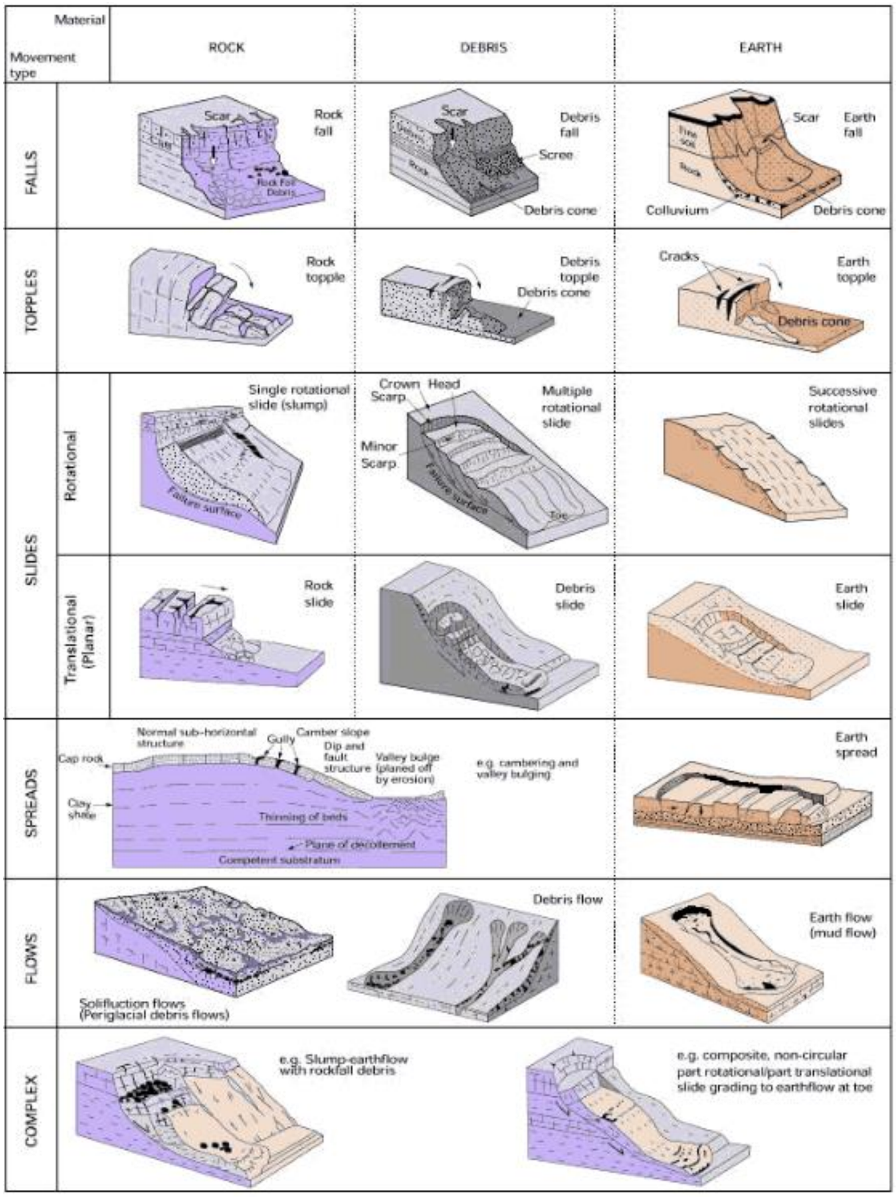


**Plate 8.1: Illustration classifying types of landslides. Image from Razin, 2012.[8]**

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[8] Bazin, S. (2012) "SafeLand guidelines for landslide monitoring and early warning systems in Europe- Design and required technology" *ResearchGate.*

The Factor of Safety (Adjusted) (Conservative approach*: Scenario B i.e., +1m surcharge relative to baseline conditions, or Scenario A) at peat probe locations is generally Acceptable with the exception of marginally stable / unstable point locations associated with deeper peat and/or steeper inclines.

* This conservative approach, in combination with conservative values used in the stability risk assessment (e.g., conservative values for moisture content, shear strength etc) (**Appendix 8.1, Section 2.2**) the assessment itself is highly sensitive to and bias towards worst case environmental conditions in terms of peat or slope stability. This gives added confidence in sample locations which are classified as acceptable, and marginally stable or unacceptable stability sample points can be identified, interrogated and further risk assessed.

The Risk Ranking (Distance) Scenario B i.e., +1m surcharge) at peat probe locations is generally Very Low to Low with the exception of Moderate or High risk point locations associated with deeper peat and/or steeper inclines and/or close proximity to sensitive receptors.

Refer to **Appendix 8.1 – Stability & Geotechnical Assessment – Sections 4 and 5** for full risk assessment results.

The following tables summarise the peat stability risk assessment data interpretation per turbine or infrastructure unit location. Note: results discussed are for Scenario B whereby 1.0m material surcharge is applied which allows for surcharges due to construction activity including stockpiled material to 1m. Aligned with Scottish Government Guidance, the Factor of Safety (FoS) values of 1.0 or greater are considered 'Acceptable' in terms of peat stability, whereas FoS ranges lower than 1.0 are deemed 'Unstable' and are classified as 'Unacceptable' (refer to **Table 2, Appendix 8.1**).

Factor of Safety (FoS) at all trial pit locations are 'Acceptable'. Note: Trial pit locations limited relative to extent of Development footprint. Subsoil stability is considered to be acceptable across the site with the exception of areas with all or a combination of the following factors; steep incline, deep till deposits, iron pan, high risk landslide susceptibility, potential for impacted hydrogeological conditions. These Geo-Hazards are identified in the following table/s and a register of Geo-Hazards is presented in **Appendix H (a – c)** and listed in **Table 13**, and **Table 14 and Table 17** of **Appendix 8.1**. The term Inferred accompanying some risk assessment conclusions is associated with areas with limited data due to access (excavator carrying out trial pits) or inferring hazards such as the presence of iron pan in subsoils from near adjoining trial pits (**Appendix H**).

### Subsoil Stability

Subsoils underlying the site are characterized generally as clayey sandy GRAVEL or TILL.

The Factor of Safety (Adjusted) (Scenario B i.e. 1m surcharge) at trial pit locations is generally 'Acceptable' with no recorded marginally stable / unstable point locations.

The Risk Ranking (Distance) Scenario B i.e., 1m surcharge) at trial pit locations is generally Very Low to Low with no exceptions of Moderate to High risk point locations.

Refer to **Appendix 8.1 – Stability & Geotechnical Assessment – Sections 4 and 5** for full risk assessment results.

**Appendix H (a – c)** of **Appendix 8.1,** details elevated risk identified (inferred) in areas possessing deeper tills and steep inclines, particularly in areas with potential for iron pan and hydrogeological impacts. Iron pan formations are associated with impervious layers within the subsoil profile. Where water would normally freely drain, percolating to groundwater, upon encountering an iron pan formation, would then either be deflected laterally or have the potential to develop a perched or high-water table.[9] [10]

### 8.3.9 Designated & Protected Areas

The GWF Site, TDR and are not within any designated or protected areas. Any potential impacts to Soils or Geology are not considered to have direct impacts to downgradient designated sites, however entrainment of soils in runoff is a significant potential impact of the Development covered under **EIAR Chapter 9: Hydrology and Hydrology.** Therefore, impacts to soil have the potential to have secondary or indirect and impacts via hydrology in particular to down gradient receptors.

Section of the proposed UGC grid connection traverse sections of designated Natural Heritage Areas (NHA) and Special Areas of Conservation (SAC) of Killarney National Park. For the proposed crossing of watercourses within these Designated Areas, where standard trenching methodologies cannot be applied, Horizontal Directional Drilling (HDD) will be utilised to facilitate underground cabling. These trenchless methods would avoid impacting the natural habitat of wildlife and bird and mitigate vegetation cutting in the designated area.

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[9] Teagasc (1982) "Some Relationships of Drainage Problems in Ireland to Solid and Glacial Geology, Geomorphology and Soil Types", *The Agriculture and Food Development Authority*.
[10] Waddington, J., Rotenberg, P. and Warren, F. (2001) "Peat CO2 production in a natural and cutover peatland: Implications for restoration", *Biogeochemistry* 54, pp. 115–130.

### 8.3.10 Turbine Delivery Route & Grid Connection Route

The Turbine Delivery Route will require road widening, one temporary bridge crossing over the Sullane River, and one turning point along the N22 (**Appendix 8.1**). Minimal land take is required for the both the Turbine Delivery Route and Grid Connection Route, considering a majority of the routes will traverse already existing roadways (i.e., existing Site Access Roads, public and local road networks and privately owned forestry access tracks. There are some areas of the delivery route that will require the widening of existing portions of roads which traverse greenfield / green verge areas, however considering the small scale of disturbance (shallow excavation, superficial paving) the impact is considered negligible to slight.

These portions of the development and associated construction impacts are similar to those described for the construction of the wind farm infrastructure. Particular attention has been required in relation to the design and methodology of the temporary bridge and associated in stream works along the Grid Connection Route, i.e., risks working within a surface water buffer zone which is detailed in **EIAR Chapter 9: Hydrology and Hydrogeology**.

## 8.4 ASSESSMENT OF POTENTIAL EFFECTS

### 8.4.1 Significance Rating

Given the condition of the site in terms of land use practices, peat and soil quality, bedrock quality etc, Land, Soils and Geology as environmental attributes at the site are considered to be of Medium Importance i.e., *Attribute has a medium quality, significance or value on a local scale* (**Section 8.2.5**).

With reference to **Section 8.2.5** of this report and as summarised in **Table 8.10: Weighted Rating of Significant Environmental Impacts – Within the Footprint of the Site**, the geological attributes within the Development are considered to be of **Low to Medium Importance** and **Low to Medium Sensitivity**, and therefore classification of any potential impacts associated with the proposed Development will be limited to Magnitudes associated with **Medium Importance**, where by the site attributes (Land, Soils and Geology) are considered to be of "*medium quality, significance or value on a local scale*".

**Table 8.10: Weighted Rating of Significant Environmental Impacts – Within the Footprint of the Site**

| Sensitivity (Importance of Attribute) | Magnitude of Impact | | | |
|---|---|---|---|---|
| | **Negligible (Imperceptible)** | **Small Adverse (Slight)** | **Moderate Adverse (Moderate)** | **Large Adverse (Significant to Profound)** |
| **Medium** | Imperceptible | Slight | Moderate | Significant |
| **Low** | Imperceptible | Imperceptible | Slight | Slight / Moderate |

In terms of determining and assessing the magnitude of impacts, categories of magnitude relate to the scale of the attribute, that is the attribute/s driving the classification of sensitivity is the area of the proposed site, and therefore scale is relative to the area of the proposed site itself. That is, the area of the site is approximately 667 ha, and the area of the proposed Development footprint is approximately 21 ha, therefore the area of the footprint of the proposed Development equates to approximately 4.78% of the area of the proposed site. This means that the land take associated with the proposed Development is considered a negative, Slight significance (Small (<15% area) impact on attribute with Medium importance), localised impact of the proposed Development.

### 8.4.2 Do Nothing Impact

Site investigations of the baseline geological and geotechnical conditions of the Site indicate the following:

- The site has already experienced impacts to baseline conditions due to the land use practices **(Figure 8.2a** and **Appendix 8.2)** including agricultural (pastures, extensive drainage), commercial afforestation activities, and peat cutting activities (**Section 8.3.3).**
- There is no indication that current land use practices have had adverse impacts in terms of ground stability, with the exception of enhanced erosion in underlying tills at a localised scale.
- The cumulative impact of afforestation on the proposed site appear to be excavation of soil to construct drainage ditches and localised drainage of the soil, and varying degrees of soil erosion due to constructed roads and tracks, constructed drainage, vehicular movements, livestock movements etc.

Should the proposed Development not proceed, the existing land-use practices will continue with associated modification of the existing environment.

### 8.4.3 Construction Phase Potential Effects

#### *8.4.3.1 Clear Fell of Afforested Areas – Pre-Mitigation*

Felling of forestry at the Site will be necessary for the Development. The likely felled area of approximately 35.4 ha will represent approximately 5.3% of the proposed site area.

This may lead to a slight increase in parameters such as nitrate, dissolved organic carbon and potassium in receiving waters flowing from the site, which is considered a negative impact of the proposed Development (this is discussed in greater detail in **Chapter 9: Hydrology and Hydrogeology**).

If the proposed Development does not take place, it is likely that the forestry at the site will eventually either be clear felled or felled in larger volumes than the amount proposed as a function of this Development.

| | |
|---|---|
| **Mechanism/s:** | • Construction activities; Excavation, handling/transport, temporary storage of soils / subsoils / bedrock, vehicle tracking.<br>• Erosion in areas impacted by construction activities.<br>• Erosion in areas with newly formed preferential pathways for water runoff.<br>• Peat / slope stability, significant or localised.<br>• Reinstatement activities; similar to construction. |
| **Impact** | • Erosion of soils and release of suspended solids entrained in runoff, intercepted by surface water network.<br>• Compaction of soils, potentially reducing recharge capacity etc. |
| **Receptor/s:** | • Soil and subsoil structure and lithology.<br>• Surface Water. Surface water quality, ecological sensitivities and WFD status. |
| **Pre-Mitigation Potential Effect:** | • Negative, direct, significant, likely, long-term to permanent. |

### *8.4.3.2 Subsoil and Bedrock Removal – Pre-Mitigation*

The removal of subsoil and bedrock for turbine base or other foundation construction is a direct, impact of the Development. This includes excavation of material associated with the development infrastructure and on site borrow pits.

During the construction phase of the Development, an increased volume of material will be excavated to facilitate the construction of turbine foundations and cable trenches along the UGC route. The Development has the potential to result in the release of contaminants, particularly suspended solids to the receiving environment during the construction phase of the project, and to a lesser extent during the operational phase relative to baseline conditions.

The amounts of subsoil and bedrock to be removed will depend on specific construction and excavation plans which are specified in **Appendix 2.1, Management Plan 4** of the Construction Environmental Management Plan (CEMP). The total volume of excavated material amounts to 141,236m$^3$ which is to be stored in the on-site borrow pits. However, this volume is dependent on the results of plate-bearing tests during the construction phase.

The removal and replacement of subsoil and bedrock for turbine foundation construction is a direct, negative, permanent, moderate to significant*, Slight weighted significance**, localised impact of the proposed Development.

The removal and replacement of subsoil and bedrock at borrow pit locations is a direct, negative, temporary / reversible, moderate to significant*, Slight weighted significance**, localised impact of the proposed Development.

*Moderate to significant – accounts for the fact that the impact will alter a sensitive aspect of the environment, however it is to a degree consistent with existing and emerging baseline trends. **Slight weighted significance – accounts for the fact that the impact will be limited to less than 15 % ("Small" **Table 8.4: Qualifying the Magnitude of Impact on Soil and Geological Attributes**) of the area of the proposed site which is classified as having Medium importance.

The removal of subsoil and bedrock to facilitate construction is a direct, negative, moderate to significant, slight weighted significance, localised impact of the proposed Development, but is considered temporary and/or reversible. However, worst case scenarios include the triggering of a significant peat-landslide event, a potentially profound, and permanent adverse impact, refer to **Appendix 8.1 - SI Report, Appendix H (a – c) GWF SI Geo-Hazards,** and **Appendix I (a – c) Peat and Subsoil Stability Risk Assessments**.

The approach and methodology in which excavation of in-situ earth materials is undertaken is very important for ground stability in any environment. Excavation has the potential to cause slippage or mass failure under certain geotechnical and hydrological conditions, for example excavating in deep saturated peat on, above or below steep inclines in peatland areas during periods of extensive rainfall.[11] It should be noted that the proposed location of turbines avoid areas with steep to severe inclines but are adjacent to such areas **(Appendix H)**. None the less, the degree of slope steepness will be considered when excavating material i.e., cut and fill, sidewalls of open excavations, movement and management of material etc. Refer to **Appendix I** and **Appendix 2.1** of the **CEMP, Management Plan 4 Peat and Spoil Management Plan.**

Mitigative and reductive measures with regard to materials budget handling and potential indirect impact on water quality from mineral subsoil and bedrock excavation activities are outlined in the mitigation section of this report.

| | |
|---|---|
| **Mechanism/s:** | • Construction activities; Excavation, handling/transport, temporary storage of soils / subsoils / bedrock, vehicle tracking.<br>• Erosion in areas impacted by construction activities.<br>• Erosion in areas with newly formed preferential pathways for water runoff.<br>• Peat / slope stability, significant or localised.<br>• Reinstatement activities; similar to construction. |
| **Impact** | • Erosion of soils and release of suspended solids entrained in runoff, intercepted by surface water network.<br>• Compaction of soils, potentially reducing recharge capacity etc. |
| **Receptor/s:** | • Soil, subsoil and bedrock structure and lithology. |

[11] Feehan, J. and O'Donovan, G. (1996) "The bod of Ireland: an introduction to the natural, cultural and industrial heritage of Irish peatland" *University College Dublin – The Environmental Institute*.

| | |
|---|---|
| | • Surface Water. Surface water quality, ecological sensitivities and Water Framework Directive status. |
| **Pre-Mitigation Potential Effect:** | • Negative, direct, profound, likely, long-term to permanent. |

### *8.4.3.3 Storage of Stockpiles – Pre-Mitigation*

Of significance, during the construction phase of the Development, is the management of excavated materials handling, storage and re-use. There is potential for direct negative impact on localised ground stability particularly in the vicinity of ongoing excavation works. For example, loading or surcharging of ground in proximity to open excavations is considered in good practices and health and safety procedures associated with excavation works, as presented in **Plate 8.2**. Direct and indirect negative impacts on surface water quality can also occur **(EIAR Chapter 9: Hydrology & Hydrogeology**). However, such impacts are considered temporary and reversible. For example, the release of soil washings and suspended solids to the surface water system and soil instability due to excessive loading (surcharge) along the side walls adjacent to open excavations are both considered temporary and reversible impacts. However, worst case scenarios include triggering of a significant landslide event particularly in areas identified as having high landslide risk (**Section 8.3.8**) (**Figure 8.5a, Appendix H, Appendix I**).

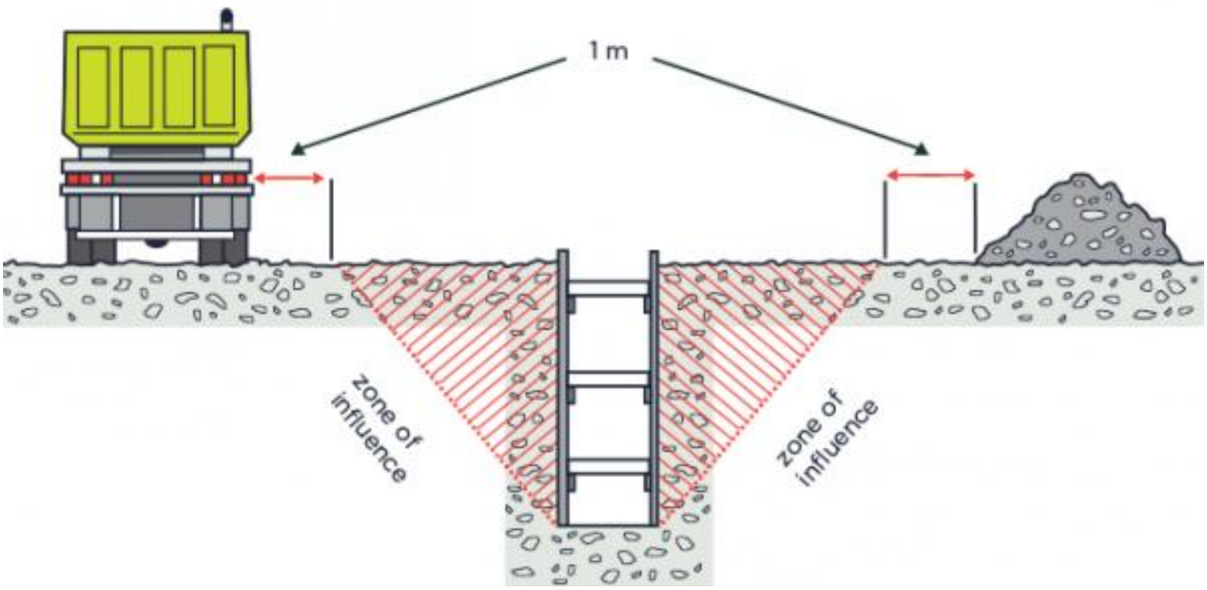


**Plate 8.2: Examples impact of loading or surcharge on ground in proximity to open excavations.**[12]

[12] New Zealand Government (2016) Good Practice Guidelines – Excavation Safety

The potential impact by construction works activity on water quality is discussed in **Chapter 9: Hydrology and Hydrogeology**.

It is envisaged that excavated material for turbine foundations will be used as back fill and reinstatement purposes, that is reused on site as appropriate, and any surplus material will be transported to the on-site borrow pit. Excavated material removed during the UGC network installation will be removed to a licensed facility. Any earthen (sod) banks to be excavated will be carefully removed and stored separately, maintained and used during reinstatement. Any surplus excavated material from roadways will be disposed of to a licenced facility. Surplus materials from Coillte tracks will be spread on and/or adjected to the track.

The potential impact on soil stability is considered a direct, negative, slight, Slight weighted significance, localised impact of the proposed Development, however, is considered temporary and reversible. Ground stability on a larger scale is discussed further in the following section.

#### *8.4.3.4 Ground Stability – Pre-Mitigation*

Ground stability, as discussed in the Baseline section of this report, is not considered an impact with significant potential under the footprint of the Development, that is the potential for slope stability issues arising or landslides to occur is generally considered Low. Some areas possess elevated risk on a localised scale (isolated pockets of deep peat). Some areas possessing elevated risk on a larger scale but outside of the Development footprint (elevated risk associated with deep till deposits, iron pan and steep inclines; and elevated risk associated with proximity of receptors with varying sensitivity).

The designed Turbine Delivery Route generally traverses areas of 'Low' Landslide Susceptibility from the Gortyrahilly Windfarm to the existing third-class road as mapped by GSI (2022). There is a stretch of proposed land take road c. 200m that has been mapped as having 'Moderately Low' to 'Moderately High' Landslide Susceptibility. The remaining extent of the TDR will utilize pre-existing third-class road infrastructure to the proposed location of the temporary bridge off the N22. While this stretch of area varies in degrees of Landslide Susceptibility ('Low' to 'Moderately High'), it is an already existing piece of infrastructure with no planned modifications to alter its design, therefore the risk of a Landslide Event is considered low. Furthermore, there have been no recorded landslide events within the immediate vicinity of the proposed Turbine Delivery Route.

The entire length of the Grid Connection Route (27.8km) varies in scale of Landslide Susceptibility, ranging from 'Low', 'Moderately Low' to 'Moderately High' with only minor pockets of 'High' risk, relative to the length of the route. Considering works necessary for the cable trenching will consist of slight excavations (1.5mbGL, with the potential for deeper excavations up to 2.0mbGL), and that works will be carried out along existing tracks, the risk of ground stability issues arising is considered low. However, it must be noted, there have been 7 no. recorded Landslide Events (OBJECTIDs: 7517, 7518, 7519, 7520, 7521, 7524, 8079) within c. 500m of the northern portion of the Grid connection Rout, documented by GSI (2022). Each landslide event took place north of the proposed route in both coniferous forests and peat bogs with 'No Apparent Impact'. The Contractor is to review highlighted work areas with a competent geotechnical engineer ahead of commencing scheduled construction.

The potential for soil stability issues to arise during the construction phase of the proposed Development is largely dependent on vehicular movement and operation during excavation works, or vehicular movements over areas with an increased or severe slope incline, and likely in combination with severe weather conditions. In terms of peat, potential impacts to hydrology can also play a large role in stability issues.

Soil stability issues brought about by excavation or vehicular movement activities on site have the potential to lead to open excavation side wall collapse, which in turn will potentially compromise ground stability in the vicinity of the works, thus increasing the effective footprint of the proposed Development. This is considered a direct or indirect, negative, moderate to significant, Slight weighted significance, localised, potentially long term but reversible impact.

Potential indirect soil stability issues including downgradient of the Development footprint brought about by construction activities are considered to be negative, significant to profound, potentially permanent impact.

#### *8.4.3.5 Geological Stability – Pre-Mitigation*

Conclusions made here are drawn with reference to **Appendix 8.1** and associated **Appendices A - I**. For further information and context in regard to methodology and definitions, refer to **Appendix 8.1**.

Geological stability will be limited to the management, excavation and breaking of weathered and competent bedrock and boulders where required. This will include a number of proposed turbine hardstand locations as well as proposed substation and borrow pits.

With reference to **Appendix 8.1** (SI Report), considering the variability of subsoil depths, bedrock depths and low rock strength (**Appendices A - G**), and in line with infrastructure manufacturer specification, further Site Investigation tailored to specifying turbine and infrastructure foundation design on a case-by-case basis is recommended, particularly areas adjacent to mapped high risk landslide susceptibility areas (GSI).

Construction activities can give rise to localised stability issues. Localised stability issues arising during construction activities, namely excavation activities includes a range of key issues, for example:

- Collapse of excavations, or sidewall collapse. This is particularly prevalent in soils with low cohesive strength and / or high groundwater levels, such as peat.
- Falling or dislodging of material.
- Operatives falling into open excavations.
- Undermining nearby structures, underground and overhead services.
- Inflow of groundwater and surface runoff.
- Damage to nearby trees.

Considering the complex topography at the Site, including steep inclines, some over sensitive receptors including dwellings (geo-hazards), there is potential for geological stability issues to impact downgradient receptors in terms of the sliding of excavation arisings towards receptors. Worst case scenarios include construction activity and the movement of excavated material triggering landslide events, for example spread or flow of stockpiled material down steep slopes outside of the Development footprint.

When considering the Grid Connection Route shallow excavations, (c. 1.3 mbGL along the cabling route and 1.75mbGL at cable joint bay locations), do not raise concern in terms of geological stability, for they are shallow in nature. Furthermore, the Grid Connection Route will follow pre-existing road infrastructure.

### *8.4.3.6 Soil Contamination – Pre-Mitigation*

Construction activities associated with the proposed Development have the potential to introduce a number of contaminants in a number of ways. Potential causing activities and associated contaminants include:

- Operation of plant vehicles and other petrol / diesel driven equipment - Hydrocarbons e.g., diesel, oil, grease.
- Wastewater sanitation – Sewage
- Construction materials – e.g., concrete or cement, bentonite clay from HDD
- General waste – e.g., plastic

**Fuel and Oil Spillages**

Hydrocarbon is a pollutant risk due to its toxicity to all flora and fauna organisms. Hydrocarbons adsorb (stick) onto the majority of natural solid objects it encounters, such as vegetation, animals, and earth materials such as peat. From a land and soils perspective, the naturally occurring chemical in crude oil and gasoline products-Polycyclic Aromatic Hydrocarbons or (PAHs), can burn most living organic tissue, such as vegetation, due to their volatile chemistry. It is also a nutrient supply for adapted micro-organisms, which can deplete dissolved oxygen at a rapid rate and thus kill off water based vertebrate and invertebrate life.

The hazard posed by hydrocarbon contamination to soil is significant in terms of adversely impacting on the health of the soils associated with the proposed site and the flora and fauna it supports, however the risk is considered limited considering the movement of same is limited. The more significant risk of hydrocarbons contamination of soils is the eventual and likely migration to surface water systems, a potentially significant negative impact - this is covered in **Chapter 9: Hydrology and Hydrogeology**.

In terms of the HDD process, drilling will involve plant machinery which will be powered by hydrocarbons, therefore risk during the refuelling process as stated previously remains the same. The risk of hydrocarbon spills stems primarily from broken hydraulic hoses used during the drilling/boring process. Small-scale quantities of greases known as 'drilling fluids' are also commonly used during the drilling process to keep components of the drill rig cool and lubricated. These drilling fluids are commonly composed of a mixture of bentonite clay, which can be harmful to the environment. Therefore, there is a risk of a potential oil leak from horizontal directional drilling (HDD) along the Grid Connection Route. It is unspecified at this time which drilling lubricant will be used during Grid Connection Route works. From experience in the industry the use of Clearbore is recommended. Clearbore is a single component polymer-based product that is designed to instantly break down and become chemically destroyed in the presence of small quantities of calcium hypochlorite. The product is not toxic to aquatic organisms and is biodegradable.

An accidental contaminant spillage would have a significant, long term to permanent, negative impact on soil quality on the Site. However, this potential impact is considered to be localised, naturally reversible (natural attenuation over a relatively medium to long term period of time), or theoretically reversible (through remediation and restoration activities over a relatively short to medium term period of time). With appropriate environmental engineering controls and measures, this potential risk can be significantly reduced.

**Drill Arisings**

Spoil arising from drilling activities will require temporary stockpiling and has the potential to be entrained by surface water runoff (suspended solids). Spoil arising from drilling activities could be mobilised by large volumes of water which would rapidly traverse overland if not managed appropriately and has the potential to mobilise additional solids via eroding soils, or other contaminants, and infiltrate the receiving surface water bodies, or groundwater bodies.

**Breakouts and drilling fluid returns**

Generally speaking, drilling fluids used in HDD practices are released at the beginning (launch) and termination (reception) sites of a borehole path, collected and disposed of properly. However, breakouts can in theory occur as a result of unstable conditions within the drilled bore due to low cohesion; for example, 1) the swelling and hydration of clay materials, 2) the movement and dispersion of clay minerals, 3) water blocks, and 4) low-permeability of mud cakes.[13] Drill fluid returns/frackouts can occur as a result of: poor drilling methods, and/or improper mud formulation used in bore drilling which can cause stability issues within the bore. Given the local lithology of the site with underlying sandy, clayey gravel and tills, potentials for breakouts must be considered. Breakouts can lead to failure in returns at either end of the bore path and subsequent drill mud being released outside the bore to the receiving environment (i.e., soils, subsoils, ground and/or surface waters).

In the case of a major spill, the leak should be stopped if safe to do so, contained and prevented from entering drains or water courses. Any recoverable product should be collected, similar in means of a hydrocarbon spill, and disposed of properly. If a significant quantity of material enters drains or watercourses, emergency services will be advised immediately.

[13] Willoughby, D. A. (2005) "Horizontal Direction Drilling Utility and Pipeline Applications" *McGraw-Hill Civil Engineering Series,* ISBN: 978-0-07-150213-9.

**Drilling Fluid Disposal**

Drilling mud containing spoil recovered from the bored path can be retrieved at the launch and reception sites of the bore. This bentonite contaminated spoil can be treated in one of two ways. It can either be transferred off-site to an approved and authorized EPA license facility (in accordance with the Waste Management Act 1996, as amended) to be properly disposed of; or the spoil can be pumped to a mechanical separation container. This involves drill mud being stored within a holding tank until separation of particulates can be achieve only then can the fluid be discharged to the surrounding area.

Very fine solids, or colloidal particles, are very slow to settle out of waters and the finest of particles require near still water and relatively long periods of time to settle, therefore, such particles are unlikely to settle despite at sufficient rates. To address this, it is recommended that flocculant is used to promote the settlement of finer solids prior to discharging to surface water networks. Flocculant 'gel blocks' are passive systems, self-dosing and self-limiting, however they still require management as per the manufactures instructions. Flocculants are made from ionic polymers. Cation polymers (positive charge) are effective flocculants; however, their positive charge makes them toxic to aquatic organisms. Anionic polymers (negative charge) are also effective flocculants, and are not toxic i.e., environmentally friendly.[14] Therefore, if flocculants are deployed the material used must be made from anionic polymers.

**Potential Effects**

A worst-case scenario could possibly occur whereby the proposed works of HDD could result in a direct, negative, potentially significant, impact of the development. This impact could result from any number of indirect anthropogenic sources, most commonly would be from: inadvertent drill returns containing bentonite clay, as mentioned above or by spillages of oil, fuel, or drilling fluid disposal. Such spillages could potentially affect the local land and soil environment, depending on the nature of the contamination issue, and to varying degrees depending on the characteristics of the Site area. Considering the proximity to surface water associated with this type of infrastructure (i.e., directly below watercourses), the risk is elevated.

While the Grid Connection Route traverses ground rated at 'X' and 'Extreme Vulnerability' (i.e., high risk) categories, this risk can be deescalated due to the lack of karst features

[14] USEPA (2013) "Stormwater Best Management Practice: Polymer Flocculation" *United States Environmental Protection Agency: Office of Water*, 4203M.

present and baseline description of the underlying bedrock aquifer. There are no karst features associated with the Site, Turbine Delivery Route or Grid Connection Route.

Further information and mitigation in relation to the management of potential contaminants is provided in **Chapter 9: Hydrology and Hydrogeology**.

### 8.4.4 Operational Phase Potential Effects

#### *8.4.4.1 Land Take Turbine Delivery Route*

Minimal land take is required for the Turbine Delivery Route, considering a majority of the route will traverse already existing roadways (i.e., existing access tracks, public and local road networks. There are some areas of the delivery route that will require the widening of existing portions of roads which traverse greenfield / green verge areas, however considering the small scale of disturbance (shallow excavation, superficial paving) the impact is considered negligible to slight.

#### *8.4.4.2 Land Take Windfarm*

The total land-take of the Development, including the Site Access Roads, Turbine Hardstands, Turbine Foundations, Grid Connection Route, Turbine Delivery Route nodes and sub-station is 135 hectares. The Site is 667 hectares therefore the total land take is 20% of the Site. Land take is a direct impact of the Development, that is land being used as forestry and agricultural pastures currently will be replaced by the Development. The extent of land take will correlate with the footprint of the Development with the exception of some existing track ways, however there is also additional land take considering required cut and fill, drainage and cable trench infrastructure, and the increased excavation foot print required for safe excavation practices (e.g. batter back, discussed in the following sections).

Excavation activities associated with land take required for the Development will lead to disturbance of otherwise generally undisturbed, greenfield land, that is, the natural soil profile, important for the purpose of facilitating current land use practices, namely agricultural pastures, will be disturbed. Without careful planning, an area excavated which can otherwise be potentially reinstated will potentially be impacted significantly and permanently. This is considered a direct, negative, significant, slight weighted significance, localised impact of the Development. With appropriate mitigation measures, planning and management this impact can be reversed and disturbance minimised.

#### *8.4.4.3 Land Take Grid Connection Route*

Minimal land take is required for the Grid Connection Route considering the line will principally be buried in or directly adjacent to existing roadways. Some of the Grid Connection Route and Turbine Delivery Route possess minor portions which traverse greenfield / green verge areas not associated with public / private forestry roads. Any such impact is described similarly to general land take described above, however considering the small scale of disturbance, shallow cable trench (c. 1.3mbGL), the impact is considered negligible to slight.

### 8.4.5 Decommissioning Phase Potential Effects

No new impacts envisaged; however baseline conditions will change over the life time of the Project, in relation to ecology and peatlands in particular.

## 8.5 MITIGATION MEASURES AND RESIDUAL EFFECTS

### 8.5.1 Design Phase

#### *8.5.1.1 Mitigation by Avoidance*

A process of "mitigation by avoidance" was undertaken by the EIA team during the design of the turbine and associated infrastructure layout. Arising from the results of this study, a constraints map was produced that identifies areas where geotechnical constraints could make parts of the site less suitable for development. Geo-Hazard constraints are mapped and presented in **Appendix I**.

The layout plan was reviewed and the best layout design available for protecting the Site's existing geotechnical (and hydrological) regime was identified, but while also incorporating and overlaying landownership, engineering and avoiding environmental constraints as detailed in this EIAR and appendices including **Appendix 8.1 - GWF SI Report- Stability and Geotechnical Assessment,** and the **Peat and Subsoil Stability Risk Assessments (Appendix I (a – c)).**

### 8.5.2 Construction Phase

Any and all direct impacts on soils/peat and bedrock arising from the Development are considered localised, therefore the above assessment and classification of the weighted significance of land take encompasses all impacts to soils and bedrock considering the Development as a whole. Therefore, impacts assessed and classified in the following section/s are considered at the localised scale, with the exception of potential indirect impacts on downgradient receptors, for example associated with Surface Water.

### 8.5.2.1 Land Take

The Site extends to approximately 667 ha, of which 154 ha is commercial forest owned by Coillte. The remaining land (513 ha) is third party property and the principal land use in the general area consists of a mix of agricultural sheep and cattle grazing, farmland, residential properties, agricultural structures and open mountain heath.

To facilitate the access roads, civil works, site compounds, borrow pits and Turbine Hardstands, 35.4ha coniferous forestry will need to be clearfelled. The felling area proposed is the minimum necessary to construct the Development and to comply with any environmental mitigation (bats in particular).

This implies that, relative to the area of the Site, the magnitude of the impact of land take equates to approximately 5.3% (Small), that is, this is considered a likely, direct, negative, localised, permanent effect of the Development. Considering the effect conforms to baseline, the significance is classified as moderate at a localised scale (conforms to existing or emerging baseline trends), and the weighted significance is Slight.

The potential impacts associated with the Grid Connection Route and Turbine Delivery Route in relation to soils and geology in general are considered slight, however, as designed, utilising as much roadway as possible will reduce the negligible to slight impact associated with land take.

### 8.5.2.2 Subsoil and Bedrock Removal

#### 8.5.2.2.1 Mitigation by Avoidance

The removal of peat and mineral subsoil / bedrock is an unavoidable impact of the Development but every effort will be made to ensure that the amount of earth materials excavated is kept to a minimum in order to limit the impact on the geotechnical and hydrological balance of the Site. This has been done initially through a process of "mitigation by avoidance" whereby the proposed turbines and infrastructure layout was dictated to a large degree by the existing infrastructure, peat depth and the topography, locating turbines in areas where the existing infrastructure is utilised, peat is shallow, and the topography is favourable. Similarly, engineered cut and fill extents which have been designed will minimise the volumes of subsoils to be removed either directly by excavation (turbine foundations) or as a function of cut and fill requirements (hardstands).

Mitigation by avoidance has been adhered to during the design phase of the temporary suspended bridge over the Sullane River along the Turbine Delivery Route, whereby concrete abutments designed to support the deck will be set back 5m from the river edge (top of bank), this allows for the avoidance of instream works, and erosion control. Furthermore, a fuel fill and spill containment area, SiltBuster and attenuation SUMP, concrete washout skip and double silt fencing as been incorporated into the design to reduce the risk of environmental incidences.

For the proposed crossing of watercourses along the grid connection route within designated NHAs and SACs, Areas, where standard trenching methodologies cannot be applied, Horizontal Directional Drilling (HDD) will be utilised to facilitate underground cabling as a form of "mitigation by avoidance". These trenchless methods would avoid impacting the natural habitat of wildlife and bird and mitigate vegetation cutting in the designated area. This methodology is explained in more detail in **EIAR Chapter 9: Hydrology and Hydrogeology.**

#### 8.5.2.2.2 Mitigation by Good Practices

Excavation of peat in areas where there is >1.0m in peat depth will follow appropriate engineering controls (**Section 9.5.2.3, Chapter 9: Hydrology and Hydrogeology)**, such as the drainage of the peat along the proposed Site tracks in advance of excavation activity (1 month in advance where possible) so as to reduce pore water content and thus instability of the peat substrate prior to excavation. Such drains will be positioned at an oblique angle to slope contours to ensure ground stability. Drains will not be positioned parallel to slope contours, that is, a gradient more than zero. It is noted that some drains will be close to parallel with elevation contours. This drainage will be attenuated prior to outfall (**Chapter 9: Hydrology and Hydrogeology** and **Management Plan 3 - Surface Water Management Plan 3, Appendix 2.1 CEMP**). It is noted that peat depth at the Site is generally shallow and management of saturated peat will be required at relatively few locations.

In those parts of the Site where excavation may intercept areas of peat that are >1.0m depth, a geotechnical engineer/engineering geologist will be onsite to supervise and manage the excavation works and confirm the necessity for supporting newly excavated peat exposures or redirect initial construction phase drainage to maintain ground stability.

For side walls in all excavations a safe angle of repose will be established. This will ensure the potential for side wall collapse will be minimised. For peat, the safe angle of repose is approximately 15°, which equates to a c. 10m horizontal distance if excavating to 2.5m depth, however given the quality of the peat, and the potential residual water content after pre excavation drainage works, or increased water content following heavy rainfall events, there remains a risk of localised stability issues arising in areas of deeper peat. Therefore, for excavation in areas of deeper peat (>2.0m) excavation supports will be used and this will be incorporated into the CEMP for the Development, for example temporary sheet piling, or similar. This will minimise the effect of excavation to the minimum required. Areas of the site where deeper (>2.0 m) peat was detected during site surveys are presented in geo-constraint maps (**Appendix 8.1).** Similarly, the safe angle of repose for subsoils at the Site (GRAVELS), or any other material (e.g., crushed rock) arising at the site have also been considered and similar consideration and mitigation applied respectively. Example soil types and respective critical angle of repose under varying conditions is presented in **Table 8.11: Critical Angle of Repose for Various Soil Types** . However, in terms of peat or loamy soils the critical angle of repose will vary greatly depending on a range of factors (peat quality, fibre content, water content, etc.). For example, the friction angle of peat varies significantly due to associated shear strengths, and undrained friction angle of amorphous peat and fibrous peat is typically in the range of 27 to 32 degrees under a normal pressure, however in some regions (West Malaysia) the friction angle is in the range 3 to 25 degrees[15].

**Table 8.11: Critical Angle of Repose for Various Soil Types [16]**

| Soil Type | Critical Angle of Repose (Degrees) | | |
|---|---|---|---|
| | Dry | Moist | Wet |
| **Top Soil (Loose)** | 35-40 | | 45 |
| **Loam (Loose)** | 40-45 | | 20-25 |
| **Peat (Loose) *NOTE*** | 15 | 45 | |
| **Clay/Silt (Solid)** | | 40-50 | |
| **Clay/Silt (Firm)** | | 17-19 | |
| **Clay/Silt (Loose)** | | 20-25 | |
| **Puddle Clay** | | | 15-19 |
| **Silt** | | 19 | |
| **Sandy Clay** | | 15 | |
| **Sand (Compact)** | | 35-40 | |
| **Sand (Loose)** | 30-35 | | 25 |
| **Sandy Gravel (Compact)** | | 40-45 | |
| **Sandy Gravel (Loose)** | | 35-45 | |

[15] Kazemian S et al (2011) A state of art review of peat: Geotechnical engineering perspective. International Journal of the Physical Sciences Vol. 6(8), pp. 1974-1981
[16] StructX (25/04/2022) Critical Angle of Repose - Typical Angle of Repose Values for Various Soil Types [Online] Available at: https://structx.com/Soil_Properties_005.html [Accessed 01/06/2022]

| Soil Type | Critical Angle of Repose (Degrees) | | |
|---|---|---|---|
| **Sandy Gravel (Natural)** | | 25-30 | |
| **Gravel (Medium Coarse)** | 25-30 | | 25-30 |
| **Shingle (Loose)** | | 40 | |
| **Shale (Hard)** | | 19-22 | |
| **Broken Rock** | 35 | | 45 |
| NOTE: Angle of repose for peat will be highly variable depending on in situ site conditions. | | | |

Adopting good practices, planning ahead and real time monitoring in more sensitive (>1m peat depth) areas will ensure that any excavations associated with the Development will have minimal impact, that is the risk of the activity of excavation having an increasing or variable impact will be reduced. Similarly, application of the above mitigation measures will reduce the risk of stability issues arising at a localised scale.

#### 8.5.2.2.3 Mitigation by Reduction

Apart from the measures taken in the design phase of the Development (avoiding the need for and reducing volumes of subsoils to be removed) there are no other reductive mitigation measures in terms of subsoil and bedrock removal, that is the layout of the Development minimises the impact of subsoil and bedrock removal in so far as practical, without compromising or reducing the Development itself.

#### 8.5.2.2.4 Mitigation by Reuse

Subsoil and bedrock which are excavated as part of the initial decommissioning and construction phase will be reused onsite where possible. It should be noted that the bedrock at the Site, Siltstone is classified as a weak rock and comprised mainly of very small silt particles. There is a risk that if used for track surfacing that the trafficked material will gradually degrade, potentially leading to chronic siltation of drainage features or dust depending on meteorological conditions. Therefore, bedrock material arising at the Site will be reused as fill material, but Site Access Roads and Turbine Hardstands will be surfaced with a harder rock imported to the Site. The imported rock will be locally sourced and similar in nature to the local area in terms of geo-chemistry. Similarly, the subsoil (GRAVELS) or till at the site possess a relatively high proportion of clay and silt particles (**Appendix D, Appendix F** and **Appendix G** of **Appendix 8.1**), which can enhance the entrainment of solids in runoff relative to other soils/materials. Therefore, similar precautions will be implemented when handling and reusing subsoil materials on site.

Excess bedrock will be reused as backfill in areas previously excavated, or as backfill in cut and fill operations, for example, Site Access Roads and Turbine Hardstands. Using the local bedrock as fill will ensure that impacts to hydrochemistry are minimised.

Geotechnical testing on imported material will be carried out prior to its reuse onsite particularly for reuse as a running or load bearing surface and will only be reused for those purposes if the suitability of same is conforms to relevant standards. Useful guidance in this regard include:

- Good Practice during Wind Farm Construction (SNH, 2015)
- Notes for Guidance on the Specification for Road Works Series NG 600 – Earthworks (TII, 2013)
- Constructed tracks in the Scottish Uplands (SNH, 2015)

Peat material excavated will be reused as backfill in areas previously excavated as much as possible, and/or for reinstatement works elsewhere on the Site. To facilitate this the acrotelm (living layer) and the catotelm (lower layer) will be treated as two separate materials. Catotelm peat will be used to backfill, for example around turbine foundation pads once established. Acrotelm peat will be used as a dressing on top of deposited catotelm peat in order to promote and re-establish flora and ensure the acrotelm layer becomes relatively cohesive in terms of localised peat stability (vegetated), refer to **Management Plan 4 of the CEMP, Appendix 2.1.**

Similarly, all soil and subsoil types or horizons identified during site investigations and during actual construction, (summary provided in **Appendix 8.1**, data presented in **Appendix D, Appendix F** and **Appendix G),** will be treated as separate materials and arisings separated accordingly. This includes, for example Acrotelm peat, catotelm pet, clays, subsoils (GRAVEL / TILL), weathered rock.

The management, movement, and temporary stockpiling of material on site, including a materials balance assessment and plan is detailed in the CEMP, this will include identification of suitable temporary set down areas which will be located within the Development footprint and will consider and avoid geo-constraints identified in this report (**Appendix H a - c**). Temporary set down / stockpile areas will be considered similarly to active excavation areas in terms of applying precautionary measures and good practices, and mitigation measures, including those relating to control of runoff and entrapment of suspended solids (**Chapter 9: Hydrology & Hydrogeology**).

#### 8.5.2.2.5 Mitigation by Remediation

The mitigation measures listed above, namely backfilling with peat in layers, are in effect remediation measures, whereby the impact of required excavation works are remediated and limited to the extent of the actual proposed infrastructure. This will be carried out at designated Borrow Pit locations, infilling with material in identified soil horizons as mentioned above to revert Borrow Pit locations to baseline levels.

Excess subsoils and bedrock will be used for remediation and reinstatement purposes elsewhere on the Site, including areas already impacted by peat cutting and agricultural activities, eroded or degraded areas, for example, reinstating original ground level in areas of cut peat and/or damming drains in peat areas.

Mitigation measures outlined here as well as in **Management Plan 4 Peat and Spoil Management Plan** in **Appendix 2.1** of the CEMP will ensure the impacts arising from excavation activities are minimised to the footprint of the Development and improve some other degraded areas of the Site, thus offsetting the adverse impacts of the Development.

It is recommended that the ongoing destructive agricultural and peat cutting practices within the Development landholding ceases for the lifespan of the project, for example, the cutting of peat and soils and the installation of drainage features at the site. With reference to **Chapter 9: Hydrology & Hydrogeology**, drainage features adjacent to the Development footprint will be designed and / or modified to include appropriate attenuation features and buffered outfalls etc.

### *8.5.2.3 Storage of Stockpiles*

#### 8.5.2.3.1 Mitigation by Avoidance and Good Practice

As discussed in previous sections, excavation of materials is unavoidable however the impacts of same can be minimised if managed appropriately. Similarly, given that excavations are unavoidable, so too are temporary stockpiles. However, if managed appropriately, the impact of same can be minimised.

No permanent stockpiles will remain on the Site. All excavated materials from the Site or introduced materials for construction will be either used or removed from the Site.

No temporary stockpiles will be positioned or placed on areas of peat which have not been assessed or are indicated as being geo-hazards, particularly in areas of unacceptable factor of safety / stability (**Appendix B, Appendix I, Appendix 8.1**). All temporary stockpiles will be positioned on established and existing hardstand areas or in designated areas which are appropriate for short term storage. Temporary storage locations have been identified in the CEMP (**Appendix 2.1**), and these areas will also be managed in terms of potential for solids entrainment by runoff (**Chapter 9: Hydrology and Hydrogeology**) .

No temporary stockpile placed on established hardstands in areas of deeper peat (**Appendix B**) will be in excess of 1m in height. This is due to potential localised stability and subsidence issues in relation to the peat under and in vicinity of the hardstand and stockpile.

As discussed in **Chapter 9: Hydrology and Hydrogeology**, stockpiling of material will invariably lead to the entrainment of solids in surface water runoff. Mitigation measures to address same are detailed in **Chapter 9**, and in **Appendix 2.1**, **Management Plan 4 Peat and Spoil Management Plan** which facilitates the near immediate reuse of material in so far as practical, thus reducing the potential for temporary stockpiles in general. For example, the material arising from the first excavation is deposited in areas identified as having potential for restoration or requiring fill, the material arising from the second excavation is used as fill and reinstatement material in the first excavation location, etc.

#### 8.5.2.3.2 Mitigation by Reduction

The volume of material to be managed including temporary stockpiling is directly proportional to the volumes of material required to be excavated, in total the volume of material is large, however when managed appropriately (ongoing reinstatement) the volume of material to be managed at any particular time will be minimised.

The Peat and Spoil Management Plan (**Management Plan 4, CEMP Appendix 2.1**) forming part of the CEMP, identifies volumes and types of materials arising, temporary stockpiling locations, routes for reuse and remediation, requirements in terms of logistics and considerations in terms of timing and planning of movements of material.

The Peat and Spoil Management Plan, **Management Plan 4, CEMP Appendix 2.1,** will ensure that the material arising from any excavation will have a predetermined plan and route for re-use / remediation, or disposal if all potential for reuse / remediation have been exhausted.

Mitigation measures for stockpiles related to the Grid Connection Route are as follow: stockpiles will be restricted to less than 2m in height and will be subject to approval by the

Site Manager and Project Ecological Clerk of Works (ECoW). Additionally, any excavated material will be later used to backfill the trench where appropriate, any surplus material will be transported to a licensed facility.

### *8.5.2.4 Vehicular Movements*

#### 8.5.2.4.1 Mitigation by Avoidance and Good Practice

Vehicular movements will be restricted to the footprint of the Development and advancing ahead of any constructed hardstand will be minimised in so far as practical. For example excavation ahead of established hardstands will be in line with expected phases of Turbine Hardstand and Site Access Road construction in terms of both delivery of and installation of material and site activity periods whereby excavations will not be opened ahead of site shut down periods. This will be done with a view to minimising soils / subsoils exposure to rain and runoff.

Ancillary machinery will be kept on established Turbine Hardstands, and no vehicles will be permitted outside of the footprint of the Development, and will not move onto land that is not proposed for the Development if it can be avoided.

Where vehicular movement are necessary outside of the Development, ground conditions will be maintained as well as possible. This includes for example replacing sods, smoothing over with excavator bucket etc. Where ground conditions are poor, or prolonged works, temporary access measures will be deployed, for example floating platforms / floating access track.

Floating tracks are applied directly to peatlands and remove the need to excavate any peat. The weight of the track structure will gradually lead to subsidence of the material, and compression of underlying peat, namely the acrotelm potentially resulting in reduced transmittance of runoff and impacting on baseline hydrological regime at the site. This can lead to excessive wetting upgradient and peatland drying and chronic degradation of water supply down gradient of tracks. Proposed drainage as part of the Development has been designed to maintain the baseline hydrological regime as far as practical (**Chapter 9: Hydrology and Hydrogeology)**

For the Grid Connection Route, before starting construction, the area around the edge of each joint bay which will be used by heavy vehicles will be surfaced with a terram cover (if required) and stone aggregate to minimise ground damage.

Adhering to the mitigation measures described herewith will minimise the adverse impacts posed by vehicular movements, and ultimately any impacts arising will be temporary considering the initial decommissioning and construction of the Development will in effect reverse any impact by vehicular movement within the Development.

Mitigation measures are specified throughout this Chapter of the EIAR (**Section 8.5)**, as well as in the Construction Environmental Management Plan (CEMP) (**Appendix 2.1**) and in **Appendix 17.1.**

### *8.5.2.5 Ground Stability*

#### 8.5.2.5.1 Mitigation by Avoidance and Good Practice

Peat and slope stability investigations at the Site (**Appendix I**) indicate that the Site has a generally low risk probability with respect to peat slippage and slope failure under the footprint of the Development. The investigation includes some key limiting factors and assumptions which should be noted:

- The area assessed is within and adjacent to the footprint of the Development.
- The assessment 'worst case scenario' assumes a maximum of 1m fill, that is, stockpiles are limited to 1m height. Where ground conditions are favourable, for example, shallow bedrock, flat and stable (Factor of Safety) areas, storage of material can be increased, but all material will be relocated / reinstated on an ongoing course throughout the construction stage, therefore volumes of stockpiles material will be minimal.

Considering the assessment conclusions are related to the Development and initial decommissioning and construction activities including vehicular movements will be limited to the Development, areas of potentially high risk (Geohazards, for example, GSI high risk landslide susceptibility) in terms of peat and slope stability will be avoided.

Temporary stockpiles will be limited to 1m height and removed for reuse/remediation purposes or disposed offsite as soon as possible. It is envisaged that all material will be reused on site, unless contaminated (for example, due to accidental hydrocarbon/fuel spill). Therefore, the risk posed by the management of material in terms of peat and slope stability is dramatically reduced if not avoided completely.

Furthermore, with a view to applying the precautionary principle, the following procedures will be adopted as best practice mitigation measures at the Site.

- All Site excavations and construction will be supervised by a geotechnical engineer/engineering geologist.

- The Contractor's * methodology statement and risk assessment will be in line with the Construction Environmental Management Plan and will be reviewed and approved by a suitably qualified geotechnical engineer/engineering geologist prior to Site operations. (* Contractor here refers to the chosen or contracted construction company at the commencement stage of the proposed Development).
- Particular attention and pre-construction assessment (developer / sub-contractor site specific risk assessment and method statement (RAMS) and on site toolbox talks etc.) and mitigation planning will be given to any new infrastructure, for example, the proposed Site tracks, culverted watercourse crossings and hardstand associated with proximal geo-hazards including for example T1, T2 and T12 which are above particularly sensitive areas of the site as discussed in the attached SI report (**Appendix 8.1**), and as presented in the constraints maps (**Appendices H (a – c)** as well as **EIAR Figures 9.8 (a – k)**)
- Any excavations that have the potential to undermine the up-slope component of a peat and / or unstable subsoil slope will be sufficiently supported by buttress, frame or rampart to resist lateral slippage. To this end, all new turbine foundation excavation locations will incorporate a safe angle of repose (**Section 8.5.2.2.2**)
- In such excavations, the groundwater level (pore water pressure) will be kept low at all times (excavation dewatering) to avoid ground stability risks (subsidence) associated with peat and careful attention will be given to the existing drainage and how structures might affect it. Draining water from the construction area will be done through advanced dewatering techniques. In particular, ponding of water will not be allowed to occur in recent excavations, particularly in any areas encountered where peat is >1m. All deliberate or incidental sumps will be drained to carry water away from the sump following rainfall. Otherwise, this water will increase hydraulic heads locally (or increased bog water or groundwater levels), increase pore water pressure and can potentially lead to instability.
- In areas of saturated peatlands, prior to excavation, drains will be established to effectively drain grounds prior to earthworks. Such drains will be positioned at an oblique angle to slope contours to ensure ground stability. Drains on areas of the Site with minimal risk of bog failure as identified by Site Investigations will be positioned at a more acute angle to the slope contour in order to reduce the velocity of surface water drainage. It is noted that deeper (>2.0 m) peat at the site is generally confined to isolated pockets and the need for measures such as sheet piling is very low.
- Due to peat's fluid-like properties, all peat excavated will be immediately removed from sloping areas. Peat will be carefully managed particularly when in temporary storage. Temporary storage areas will be isolated from the receiving environment by means of

temporary infrastructure such as boundary berms comprised of subsoils sourced at the site, or similar material. There is potential for large volumes of bog water draining from new stockpiles which will also be managed. Mitigation will include removal of gross solids from runoff prior to bog water intercepting the wind farm drainage network. Temporary measures such as dewatering and pumping through silt bags will be employed to assist this process. Draining of stockpiled peat, in a controlled manner is recommended, (**Management Plan 4 CEMP Appendix 2.1),** with a view to reducing the weight and mobility of the material, therefore reducing risk in terms of localised stability. Similar measures will be applied to the management of subsoil arisings at the site.

- Peat is required for reinstatement, therefore acrotelm peat (top living layer, c. 0.5m) will be stripped off the surface of the bog and placed carefully at the margins of the Development along the Site track and hardstand margins that are characterised by near-horizontal slopes (<6°).
- Relatively high impact construction activities (e.g., excavations, movement of soils / subsoils / rock) are acceptable to be carried out throughout the year, when taking into account the various restrictions of the Development. However, considering the variability of metrological conditions and the potential for significant events to occur at any stage of the year, the construction phase will be limited to favourable meteorological conditions. In order to mitigate for particular earth works tasks and suitable meteorological conditions, construction activities will not occur during periods of sustained significant rainfall events, or directly after such events (allowing time for work areas to drain excessive surface water loading and discharge rates reduce).
- From examination of factual evidence to date, the majority of landslides occur after an intense period of rainfall. Stability issues at a localised scale will be similarly impacted by rainfall events, particularly when dealing with exposed soils or open excavations. An emergency response system will be developed for the construction phase of the project, particularly during the early excavation phase. This, at a minimum, will involve 24-hour advance meteorological forecasting (Met Eireann download) linked to a trigger-response system. When a pre-determined rainfall trigger level is exceeded (e.g. one in a 100-year storm event or very heavy rainfall at >25mm/hr), planned responses will be undertaken. These responses will include, cessation of construction until the storm event including storm runoff has passed over. Following heavy rainfall events, and before construction works recommence, the Site will be inspected and corrective measures implemented to ensure safe working conditions, for example dewatering of standing water in open excavations, etc.

- Any impact to the hydrological and/or hydrogeological regime will be avoided as far as practical in relation to identified Geo-Hazards (**Appendix H**) where the presence of steep inclines, deep till deposits and iron pan give rise to elevated ground stability, particularly where the potential for impacts to hydrogeology in those area / subsoils exists. For example, runoff from constructed hardstands will not be diverted and discharged into Geo-Hazard areas where possible. If unavoidable, due to slope direction etc., erosion control will be implemented, as discussed under **Chapter 9: Hydrology and Hydrogeology**. Consequences of impacting, diverting and/or concentrating runoff in geo-hazard constraints will potentially impact on stability at the site. The increased likelihood of this issue is particularly pronounced in geo-hazard areas including for example; slope to the north / north west of T1 and T2 where the occurrence of steep incline, deep till deposits, presence of iron pan, and extensive existing drainage network some of which is dramatically impacted by erosion, means that this area is elevated risk in terms of stability and significant changes to the hydrology regime in this area could potentially trigger a stability event such as a mass movement or landslide.

Mitigation measures are also described in the CEMP, **Appendix 2.1** and in **Appendix 17.1**.

#### 8.5.2.5.2 Mitigation by Reduction

The temporary storage of construction materials, equipment, and earth materials will be kept to an absolute minimum during the construction phase of the Development. This will be achieved by means of appropriate planning and logistical considerations forming part of the CEMP (**Appendix 2.1**), similar to the measures set out in relation to the management of spoil on the Site.

For example, the excavation material for the construction of access track will not progress ahead of actual track construction (as discussed under mitigation addressing vehicular movements), therefore minimising the volume of arisings to be managed. Areas for permanent deposit of material e.g., backfill adjacent to constructed infrastructure, will be identified and suitable material deposited as it becomes available. These efficiencies will be designed into the detailed CEMP (**Appendix 2.1**).

#### 8.5.2.5.3 Mitigation by Remediation

There are no indications of significant issues on the Site in terms of ground stability, however excavation and construction activities will lead to some impacts with respect to the immediate area adjacent to the Development and areas impacted by potential localised stability issues. In these instances, remediation of soils will include the deposit of suitable material where required. This will include replacement of soils / subsoils in line with baseline conditions and soils horizons. For example, the three principal materials excavated in order of depth will include peat / peat soil (including segregated acrotelm (top living layer) and catotelm peat) or topsoil at the surface, till, and crushed rock. Remediated areas will be managed and monitored in terms of reestablishment of vegetated cover.

In the unlikely event that a peat or slope stability issue does arise on the Site during the construction or operational phases of the Development, emergency response measures have been prescribed below and as part of the Construction Environment Management Plan, **Appendix 2.1 - Management Plan 1**.

#### 8.5.2.5.4 Emergency Response and Monitoring

Mitigation measures as outlined in the previous sections will reduce the potential for stability issues arising during the initial decommissioning and construction phase of the Development. However, there remains a low risk of stability issues arising, particularly at a localised scale.

Emergency responses to potential stability incidents have been assessed (**EIAR Chapter 16: Major Accidents and Natural Disasters**) and established to form part of the CEMP, **Management Plan 1, Emergency Response Plan** before construction works initiate. The following potential emergencies and respective emergency responses are addressed in brief under **Section 6.1: Procedures to be followed in the event of an incident** in **Management Plan 1**:

- Peat stability issues at a localised scale during excavation works – In the event that soil stability issues arise during construction activities, all ongoing construction activities at the particular area of the Site will cease immediately, the assigned geotechnical supervisor will inspect and characterise the issue at hand, corrective measures will be prescribed. Localised stability issues will likely occur with a broad range in severity including; minor side will collapse with no significant impact, to relatively significant areas of peat being impacted by excavation activities, or in worst case scenarios localised stability at one location triggering a chain of events leading to significant peat or slope stability issue arising. The assigned geotechnical engineer will assess each scenario and will escalate to the following mitigation scope as the need arises.

- Provision for a peat stability monitoring programme to identify early signs of potential bog slides (pre-failure indicators, for example cracks forming). This will be done in line with Scottish Governments' "Peat Landslide Hazard and Risk Assessments".[17]
- Significant peat or slope stability issues during construction activities – In the unlikely event that soil and slope stability issues arise during construction activities, all ongoing activities in the vicinity will cease immediately, all operators will evacuate the area by foot, if safe to do so, until the area is assessed by competent person/s, the assigned geotechnical supervisor will inspect and characterise the issue at hand, corrective measures will be prescribed. The area impacted will be characterised fully and risk assessments completed prior to any further works commencing at or near the location. This assessment will be phased including initial rapid response Phase 1 Assessment which will include at a minimum the prescription of exclusion zones and preliminary mitigation steps to be taken, for example, the management of runoff in or from the affected area.

Considering the highly dynamic nature of peat or soil stability issues at any particular site, it is important to establish an equally dynamic yet robust framework to follow in the event of an incident. Establishment of an emergency framework will follow relevant guidance to initially qualify any incident (by on site competent geotechnical engineer) and risk assess the area, and to then apply initial measures and design a complete emergency / contingency plan in line with an established structured emergency response. Relevant guidance includes as presented in Section 8.2.2 will be adhered to.

Emergency response will prioritise isolating and containing any materials which is being or will be intercepted by the established drainage network or receiving surface water network. Emergency materials and equipment requirements will be identified, incorporated in the CEMP, and will be managed on site with a view to be being easily accessible and readily available.

On site training and toolbox talks will ensure any response to any potential incident is mobilised quickly and efficiently.

The following is a non-exhaustive list of potential emergencies and respective emergency responses:

[17] Scottish Government (2017) "Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Developments" *Energy Consents Unit Scottish Government.*

- Peat stability issues at a localised scale during excavation works – In the event that soil stability issues arise during construction activities, all ongoing construction activities at the particular area of the Site will cease immediately, the assigned geotechnical supervisor will inspect and characterise the issue at hand, corrective measures will be prescribed.
- Significant peat or slope stability issues during construction activities – In the unlikely event that soil and slope stability issues arise during construction activities, all ongoing activities in the vicinity will cease immediately, operators will evacuate the area by foot, the assigned geotechnical supervisor will inspect and characterise the issue at hand, corrective measures will be prescribed.

This is in combination with mitigation measures as described under EIAR **Chapter 9: Hydrology and Hydrogeology** whereby precautionary measures e.g., silt screen fencing etc. will be in place. Emergency response above existing or in place measures might include crudely building dams with an excavator to attenuate or direct flow until conditions stabilise, depositing subsoil or crushed rock material to dam drainage channels, and reactionary dewatering through silt bags to appropriate areas of the site i.e., vegetated area and without impacting on problem area in terms of stability.

### *8.5.2.6 Soil Contamination*

Soil contamination, or the potential for same, is an inherent risk associated with any development. As such, good practice during construction activities, as detailed in the CEMP **(Appendix 2.1),** will address and minimise the potential for soil contamination to occur however, additional detail is provided in the following sections to facilitate linking good practices to the site-specific sensitivities of the Development

#### 8.5.2.6.1 Mitigation by Avoidance

Contaminants which pose the most significant risk to soils, namely hydrocarbons and construction materials such as cement / concrete, pose an even greater risk to surface waters and groundwaters. In the event an accidental discharge were to occur without mitigation, contaminates will likely leak or be spilled on soils initially. Protecting soils from such will in turn mitigate against the potential for contaminates reaching the hydrological network associated with the Site, however given that such features are fundamental to the potential effect of contaminants down gradient of surface water receptors, mitigation measures for contaminants are presented in detail in **Chapter 9: Hydrology and Hydrogeology**.

As discussed, construction activities will be restricted to the footprint of the Development, therefore the potential for contaminants reaching soils is likely limited to the footprint of the Development or construction area. There remains the potential for contaminant migration through soils however, scope for migration is limited considering the site geology i.e., peat / loamy soil with low permeability and transmissivity rates, and similarly poorly productive bedrock aquifers with only localised connectivity. The highest permeability and transmissivity rates at the site are attributed to the underlying till / gravels. It is also noted that the scale of any potential contamination impact will likely be minor in scale, for example, plant machinery leak (on exposed ground), as opposed to a fuel tank rupture (in bunded structure).

#### 8.5.2.6.2 Mitigation by Reduction

The potential for contaminants will be reduced by managing the importation and mobilisation of equipment and materials associated with the Development, as follows:

- Excess packaging and other materials will be discarded appropriately at the Temporary Construction Compound before advancing to the destined construction area.
- Any vehicles coming onto the Site will be required to be inspected and cleaned before leaving the Temporary Construction Compound before advancing to the destined construction area.
- Precast concrete will be used wherever possible i.e., formed offsite. Elements of the Development where precast concrete will be used have been identified and are indicated in the CEMP. Elements of the Development where the use of precast concrete will be used include e.g., structural elements of watercourse crossings (single span / closed culverts) as well as cable joint bay structures. Elements of the Development where the use of precast concrete is not possible includes e.g., turbine foundations. Where the use of precast concrete is not possible the following mitigation measures outlined in **Chapter 9: Hydrology and Hydrogeology** will apply.

#### 8.5.2.6.3 Mitigation by Remediation

Mitigation by remediation, for example, housekeeping, maintenance etc, in terms of waste or contaminants will be an ongoing measure throughout the construction phase of the Development, that is any and all contaminants will be removed from the Site in an appropriate manner when ever produced or observed.

Waste management measures to avoid Site pollution are specified in the CEMP, **Management Plan 5, Appendix 2.1** and **Chapter 13: Material Assets**.

#### 8.5.2.6.4 Emergency Response

Mitigation measures as outlined in the previous sections will reduce the potential for soil contamination during the construction phase of the Development. However, there remains the risk of accidental spillages and or leaks of contaminants onto soils.

Emergency responses to potential contamination incidents have been assessed (**EIAR Chapter 16: Major Accidents and Natural Disasters**, have been established as a Part of **Chapter 9: Hydrology and Hydrogeology, Section 9.5.2.14**, and form part of the Construction Management Plan, **Management Plan 1** before construction works initiate. Potential emergencies and respective emergency responses are assessed below:

- Hydrocarbon spill or leak – Hydrocarbon contamination incidents will be dealt with immediately as they arise. Hydrocarbon spill kits will be prepared and kept in vehicles associated with the construction phase of the Development. Spill kits will also be established at proposed construction areas, for example, a spill kit will be established and mobilised as part of the turbine erection materials and equipment. Suitable receptacles for hydrocarbon contaminated materials will also be at hand.
- Significant hydrocarbon spill or leak – In the event of a significant or catastrophic hydrocarbon spillage, emergency responses will be escalated accordingly. Escalation can include measures such as the installation of temporary sumps, drains or dykes to control the flow or migration of hydrocarbons, excavation and disposal of contaminated material.
- Cementitious material – Cement / concrete contamination incidents will be dealt with immediately as they arise. Spill kits will also be established at proposed construction areas, for example, a spill kit will be established and mobilised as part of the turbine erection materials and equipment. Suitable receptacles for cementitious materials will also be at hand.

Emergency contact numbers for the Local Authority Environmental Section, Inland Fisheries Ireland, the Environmental Protection Agency and the National Parks and Wildlife Service will be displayed in a prominent position within the vicinity of works. Additionally, emergency responses, including methodologies, are specified in the **Management Plan 1 of the CEMP Appendix 2.1.**

In the event of a significant contamination or pollution incident e.g., discharge or accidental release of hydrocarbons / fuel to surface water systems, contamination occurrences will be addressed immediately, this includes the cessation of works in the area of the spillage until the issue is resolved. The relevant authorities, noted above and stakeholders will also be promptly informed.

Refer to **Chapter 9: Hydrology & Hydrogeology** for further information.

#### *8.5.2.7 Material and Waste Management*

A site-specific Peat and Spoil Management Plan and a Waste Management Plan has been prepared as part of **Appendix 2.1, Management Plan 4**. All excavated earth materials will either be re-used in an environmentally appropriate and safe manner e.g., landscaping and bog restoration OR removed from the Site at the end of the construction phase. No permeant stockpiles will be left on the site.

Any surplus of natural materials (e.g., peat) to be used as backfill or deposited elsewhere in the Site will not be deposited to above existing ground level for the area in question. This ensures that peat used as backfill around newly established turbine foundations will not exceed local ground level, and any peat or natural materials deposited elsewhere, for example peat cutting areas, will not exceed original ground level. In essence, no permanent stockpiles will be established as a product of the construction phase of the Development, or associated restoration activities as all materials will be re-used as much as possible on-site.

Excavated materials onsite will be reused and recycled according to the Waste Hierarchy as much as possible. Where it is not possible to do so, any excess materials (road building materials) or artificial (PVC piping, cement materials, electrical wiring etc.) will be taken offsite and disposed of at a licensed facility at the end of the construction phase, refer to **Appendix 2.1**, **Management Plan 5: Waste Management**.

Any accidental spillage of introduced materials, such as concrete, will be removed from the Site.

The CEMP will include scheduled checks on equipment, materials storage and transfer areas, drainage structures and their attenuation ability (covered in greater detail in the Hydrology chapter of this report) on an ongoing / daily basis during the construction phase of the project. The purpose of this management control is to ensure that the measures in place are operating effectively, prevent accidental leakages, and identify potential breaches in the protective retention and attenuation network during earthworks operations. In addition, all such management plans will be revised as 'live' documents, so that lessons learned and improvements will be made over course of the Development.

It is noted that the Development intends to reuse all surplus excavated material at the site, however in the event of waste arising at the site, management of waste arising from the construction phase of the Development will require classification, appropriate transfer, and appropriate disposal. Waste streams will vary and will include the following potential categories:

- Inert / Non-Hazardous Soils & Stones (EWC Code: 17 05 04) – greenfield subsoils and bedrock is likely to be Inert. This could include surplus coarse / hardcore aggregate contaminated with soils remaining at the end of the construction phase of the development.
- Hazardous Soils & Stones (EWC Code: 17 05 03*) or oily waste (spill kit consumables) – Soils or any materials with significant hydrocarbon contamination will likely be hazardous due to Total Petroleum Hydrocarbon concentrations. Soils impacted by significantly by cementitious material contamination will likely be hazardous due to elevated pH concentrations.

Materials and waste management practices are be specified and detailed in **Appendix 2.1**.

#### *8.5.2.8 Clear Fell of Forestry*

No new impacts or remediation measures are associated with forestry activities. However, good practices working in specific environments such as forested areas will be adhered to including working outside of surface water or other buffer zones, and risk assessing on a case-by-case basis in terms of drainage intercepting run off, ecological sensitivities, etc.

Further mitigation measures in regard to the management of forestry operations are detailed in application report Veon Ltd. (March 2022) Forestry Report – Proposed Windfarm at Gortyrahilly Co. Cork, (**Appendix 2.2**) including:

- Phased felling approach,
- Minimising erosion by use existing tracks and use of brash for off track areas,
- Follow all relevant forestry guidance and policies, including:
  - Forest Protection Guidelines
  - Forestry and Water Quality Guidelines
  - Forest Harvesting and Environmental Guidelines
  - Forestry and Freshwater Pearl Mussel Requirements - Site Assessment and Mitigation Measures
  - Forest Biodiversity Guidelines
  - Forestry and The Landscape Guidelines
  - Forestry and Archaeology Guidelines

- The permanent felling of 35 ha of forestry is subject to replacement obligations. Replanting elsewhere will be completed.

#### *8.5.2.9 Managing & Reporting Environmental Incidents*

Environmental incidents including accidental spillages on soils (e.g., fuel) and significant environmental incidents (e.g., landslide) will be reported to the Local Authority as part of emergency responses to such incidents. Incident notification will be escalated to relevant third parties where relevant e.g., Inland Fisheries Ireland (IFI) if surface water receptors are intercepted (**Chapter 9: Hydrology & Hydrogeology**).

#### *8.5.2.10 Construction Phase Residual Impacts*

Mitigation measures outlined in this report lay down the framework to reduce all potential impacts of the Development on Geological receptors. It is noted that geological mitigation measures and impacts are strongly connected to those related to Hydrology and Hydrogeology. Furthermore, the mitigation laid out in this chapter provides mitigation by avoidance measures for hydrology and hydrogeology impacts. The Mitigated Potential Impacts lay down the achievable benchmarks provided measures are considered and implemented adequately.

| Impact | Mitigated Impact |
|---|---|
| Land Take | Direct, negative, slight to moderate, localised, conforms to baseline, unavoidable, permanent (for the life of the Development). Reversible after decommissioning and restoration. |
| Subsoil and bedrock removal | Direct, negative, slight to moderate, localised, conforms to baseline, unavoidable, permanent. |
| Storage of stockpiles (general) | Direct, negative, slight to moderate, localised, conforms to baseline, likely, temporary/permanent. Material will be used to infill and reinstate borrow pit areas, this deposit will be permanent (for the life of the project / longer), and any excess material will be removed from site in an appropriate |

| Impact | Mitigated Impact |
|---|---|
| | manner. Likely impacts mitigated under **Chapter 9: Hydrology and Hydrogeology**. |
| Compaction, erosion and degradation of peat / soils arising from vehicular movement | Direct, negative, slight to moderate, localised, conforms to baseline, avoidable, long term to permanent, reversible. |
| Stability issues and slope failure arising from construction activities | Direct, negative, slight to significant, localised to large scale, conforms to baseline (regional), avoidable, long term to permanent, reversible at localised scale. |
| Contamination – Hydrocarbons, cement, construction, general. | Direct, negative, significant, localised, contrast to baseline, avoidable, long term to permanent, reversible (*if managed appropriately). If intercepted by drainage / surface water indirect impacts are larger scale and of greater magnitude. **EIAR Chapter 9: Hydrology and Hydrogeology**. |

### 8.5.3 Operational Phase

No new impacts are anticipated during the operational phase of the Development on the geological, geomorphological and geotechnical environment therefore no additional mitigation measures are required.

Maintenance and monitoring during the operational phase of the Development pose similar hazards and risks associated with the construction phase but to a far lesser extent, for example, the potential for fuel spills from vehicles, etc. The mitigation measures described in this EIAR chapter will be adopted and implemented.

Regular monitoring, similar to the construction phase but on a less frequent basis will be required. For example, the Development will be inspected on a routine quarterly basis and following storm events. Any potential issues arising will be noted and remedial action taken in line with construction phase mitigation.

### 8.5.4 Decommissioning Phase

No new impacts are anticipated during the decommissioning phase of the project (removal of turbines and similar infrastructure on the geological, geomorphological and geotechnical environment) therefore no new mitigation measures are required, however the decommissioning of major infrastructure including proposed turbines poses similar hazards and risks to the environment compared to that of the construction phase.

Restoration of the Site following decommissioning of the proposed infrastructure is in its own right a phase of the Development. Restoration activities have the potential to be disruptive and hazardous to the environment, to the point that a 'benefit analysis' will likely be required to evaluate any such activity before it is permitted.[18]

Examples of likely difficulties impeding restoration highlighted by means of 'benefit analysis' in terms of soil and geology include the following:

- Removal of Turbine Foundations – Significant disturbance due to the difficulties associated with excavating, breaking concrete, cutting steel, loading and transferring foundation materials offsite, and subsequent disturbance associated with the excavation of suitable material to be used as fill to replace the turbine foundation. Vibration caused, particularly in relation to
- the breaking of concrete, may impact on peat and slope stability locally. Turbine Foundations will likely be left in situ.
- Removal of Hardstand / Site Access Roads – Significant disturbance due to operations associated with excavation and removal of hardstand materials. Removal of such materials will likely impact on blanket bog directly adjacent to the Turbine Hardstand area in question, and change the hydrological characteristics of the area in question (**Chapter 9: Hydrology and Hydrogeology**).
- The material required to reinstate any areas where infrastructure is removed will need to be sourced from elsewhere on the Site. Considering the elapsed time (reasonable to presume >35 years) the acquisition of natural material itself will likely do more harm (to established blanket bog) than that of the benefit of removing and restoring infrastructure associated with the Development.

Ultimately, any such restoration activities will need to be assessed under the scope of multiple environmental disciplines, similar to this EIAR, and the potential synergistic effects.

[18] Schumann, M., and Joosten, H. (2008) Global Peatland Restoration Manual. Institute of Botany and Landscape Ecology. Greifswald University, Germany.

Given that the condition of the environment will likely change over the course of the operational phase of the Development, particularly in terms of the condition and degree of establishment of blanket bog and associated ecology, and ornithology, it is recommended that the potential for restoration following the decommissioning phase of the Development is evaluated closer to the time (c. 25-30 years). It should be noted that restoration activities do not currently conform to baseline conditions.

Excavation and removal of some hardstand areas is planned as part of the Development and will be undertaken during the decommissioning phase. Excavation of all material including concrete turbine foundations will likely not be proposed due to the high impact nature of such works e.g., breaking of reinforced concrete. Extensive vehicular movement on peat is not anticipated to any significant extent considering adequate Turbine Hardstand will have been established, however the risk of fuel or other contaminant spillages, or management of waste are valid hazards during the decommissioning phase of the Development. The mitigation measures described in this EIAR chapter will be adopted and implemented by means of a Decommissioning Plan.

On the basis that a Decommissioning Plan has been established, **Management Plan 6** of the CEMP **(Appendix 2.1)** and will be implemented during the decommissioning works associated with the Development, potential issues arising giving cause to residual impacts are likely to be infrequent, imperceptible to slight, localised and reversible.

Residual impacts after the decommissioning phase are complete include all impacts classified as being long-term to permanent effects of the Development, that is, there will remain a change in ground conditions at the Site with the replacement of natural materials such as peat, subsoil and bedrock by concrete, subgrade and surfacing materials. This is a localised, negative, moderate significance, Significant / Moderate weighted significance, direct permanent change to the materials composition at the Site. However, the carefully managed reintroduction and/or reuse of soils and peat at the Site in place of Turbine Hardstand areas, and successful habitat management, revegetating and rewilding of those areas will have beneficial impacts, or revert to baseline conditions preconstruction phase.

### 8.5.5 Cumulative Effects

Considering the discipline under investigation, soils and geology, and the fact that potential effects of the Development on same are generally localised, the cumulative effects of the Development are not considered to vary dramatically or behave synergistically when considering the Site as a unit, or indeed when considering in conjunction with other developments in the vicinity or downgradient of the Site. However, on a national scale the importance of soils and peatlands in particular in terms of ecological value and carbon value must be considered. the cumulative impacts associated with hydrological and hydrogeological characteristics of the Site are also identified in **Chapter 9: Hydrology and Hydrogeology**.

## 8.6 SUMMARY OF SIGNIFICANT EFFECTS

This chapter comprehensively assesses all scenarios within the Turbine Range which is described in **Section 8.1.1.1.** The potential impacts that could arise from the Proposed Development during the construction, operational and decommissioning phases relate to the potential for increased stability issues and suspended sediment concentrations associated with site preparation activities and excavations for the infrastructure elements including the turbine foundations and cable trenches. There will be no change to the potential impacts or predicted effects irrespective of which turbine is selected within the Turbine Range.

The unavoidable residual impacts on the soils and geology environment as a function of the Development is that there will be a change in ground conditions at the Site with natural materials such as peat, subsoil and bedrock being replaced by concrete, subgrade and surfacing materials. This is a localised, negative, moderate significance at a local scale, Slight weighted significance at the scale of the Site, direct permanent change to the materials composition at the Site.

Other potential impacts are considered to range in significance from slight to significant, and can potentially be long term to permanent, however the mitigation measures prescribed will ensure the risk of such potential impacts can be significantly reduced or are considered avoidable.

No new impacts are anticipated during the operational phase of the Development. Similar hazards are identified when comparing the construction and operational phases of the Development, however considering that works will be far less intensive during the operational phase the likelihood of impacts is low, thus the risk is low.

No new adverse impacts are anticipated during the decommissioning phase of the Development however the phase will be considered similar in nature to the construction phase in terms of hazards and application of mitigation measures. Baseline conditions will be qualified again towards the end of the lifetime of the project (c. 25-30 years). Managed appropriately, the restoration of the site following the decommissioning phase will have neutral to beneficial impacts relative to baseline conditions.