# 8 SOILS AND GEOLOGY

## 8.1 INTRODUCTION

This chapter assesses the impacts of the Project (**Chapter 1: Introduction**) on soils and geology environment. The Project refers to all elements of the planning application for the construction of Inchamore 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 Project:

- Construction of the Project;
- Operation of the Project, and
- Decommissioning of the Project.

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:

- **Figure 8.1(a) –** Site Location & Layout Wind Farm
- **Figure 8.1(b) –** Site Location & Layout Grid Connection Route
- **Figure 8.2(a) –** Land Use Wind Farm
- **Figure 8.2(b) –** Land Use Grid Connection Route
- **Figure 8.3(a) –** Geology Wind Farm
- **Figure 8.3(b) –** Geology Grid Connection Route
- **Figure 8.4(a) –** Soils Wind Farm
- **Figure 8.4(b) –** Soils Grid Connection Route
- **Figure 8.5(a) –** Subsoils Wind Farm
- **Figure 8.5(b) –** Subsoils Grid Connection Route
- **Figure 8.6(a) –** Landslide Risk & Events Wind Farm
- **Figure 8.6(b) –** Landslide Risk & Events Grid Connection Route
- **Figure 8.7 –** Geo-Hazards Constraints Map Wind Farm

- **Appendix 8.1 –** Site Investigation and Peat Slide Risk Assessment
- **Appendix 8.1 – App A1 –** IWF SI – Peat Depth Overview
- **Appendix 8.1 – App A2 –** IWF SI – Peat Depth – Tile 1
- **Appendix 8.1 – App A2 –** IWF SI – Peat Depth – Tile 2
- **Appendix 8.1 – App B –** Peat Database
- **Appendix 8.1 – App C –** IWF SI – Trial Pit and Borehole Locations
- **Appendix 8.1 – App D –** IWF SI – Trial Pit Logs
- **Appendix 8.1 – App E –** IWF SI – Trial Pit Photos

- **Appendix 8.1 – App F –** IWF SI –Borehole Log
- **Appendix 8.1 – App G –** IWF SI – Subsoil Laboratory Certificate
- **Appendix 8.1 – App H (a) –** IWF SI – Geohazards Overview
- **Appendix 8.1 – App H (b)** – IWF SI – Geohazards W NW
- **Appendix 8.1 – App H (c) –** IWF SI – Geohazards E SE
- **Appendix 8.1 – App I –** IWF SI – Stability Risk Matrices

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 Project, any condition(s) relating to a CEMP which will be attached 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 Assessment Structure

In line with the EIA Directive, as amended and Guidelines on the information to be contained in Environmental Impact Assessment Reports (EPA, May 2022), 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 Project, during the construction, operational and decommissioning phases..
- Mitigation measures to avoid or reduce the impacts identified.
- Identification and assessment of residual impact of the Project considering mitigation measures.
- Identification and assessment of cumulative impacts if and where applicable.

### 8.1.2 Project Description

The Project (**Figure 9.1a-b**) is described in **Chapter 2: Project Description**.

### 8.1.3 Statement of Authority

Minerex Environmental Ltd. (MEL), an RSK group company was commissioned to carry out this Chapter of the Environmental Impact Assessment Report. RSK Group, is a consultancy providing environmental services in the hydrological, hydrogeological and other environmental disciplines. The company and group provide consultancy to clients in both the public & private sectors. More information can be found at www.rskgroup.ie. The members of the RSK EIA team involved in this assessment include the following persons:

- Sven Klinkenbergh – B.Sc. (Environmental Science), P.G.Dip. (Environmental Protection) – Principal Environmental Consultant, Project Manager and EIA Lead Author with c. 10 years industry experience in the preparation of geological, hydrological and hydrogeological reports.
- Project Scientist: Jayne Stephens - B.Sc. (Environmental Science), PhD (Environmental and Infection Microbiology). Jayne is an Environmental consultant with c. 5 years' experience working in microbiology, water, and environmental disciplines. She graduated with a BSc in Environmental Science from National University of Ireland Galway in 2014, majoring in mammal ecology. Following this, Jayne was the successful Irish applicant to the Tropical Biological Association in Cambridge to complete a field course in tropical biodiversity and conservation in Tanzania. She holds a PhD in environmental microbiology, graduating in 2023. Jayne has worked on a large number of bathing water and surface water monitoring investigations, on project Acclimatize, an EU funded project which aimed to bridge the knowledge gap in relation to at-risk urban and rural bathing waters in Ireland and Wales. During this project, Jayne was team lead for site investigations and has a number of years' experience on microbial contamination and public involvement projects for better water quality.
- Lissa Colleen McClung - B.Sc. Environmental Studies (hons.), M.Sc. Environmental Science (hons.). Current Role: Graduate Project Scientist. Colleen has recently joined RSK Ireland as a Graduate Project Scientist under the Hydrology & Hydrogeology and Land, Soils & Geology Team. After attaining an MSc in Environmental Science, with 1.1 First Class Honours, from Trinity College Dublin in 2021. Since coming on board, Colleen has worked on a variety of projects for urban residential development schemes and renewable energy. As a Project Scientist, Colleen has undertaken technical report writing in many forms, such as: Flood Risk Assessments (Stage 1 and Stage 2) (ROI), Drainage Assessments (NI), Water Framework Directive Assessments, Environmental Impact Assessment Reports (ROI) and Environmental Statements (NI). She has also carried out extensive field work around the country. Key capabilities include preparation of Environmental Impact Assessment Reports and running software such as QGIS, Python and MATLAB coding languages.
- Mairéad Duffy - B.Sc. Environmental Management, M.Sc. Climate Change. Current Role: Graduate Project Scientist. Mairead has experience in technical report writing and field work surveying of hydrological and geological elements of the environment with associated proposed green energy projects around the country.

## 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 Project on the soils, geology and ground stability aspects of the environment at the Inchamore 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 Project design.
- Consider ground stability issues as a result of the Project, 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.

#### *8.2.1.1 Assessment Principles*

Direct impacts or effects on geological attributes or soils themselves are localised in the context of soils and geology (e.g., excavated soils from holes, stored and used as back fill). However, in many instances, these geological impacts give rise to the potential sources of contamination by water run off (i.e., indirect or secondary impacts) to ecological and hydrological receptors. For example: Contamination of soils / peat by cementitious material is considered a localised impact, however if cementitious contamination is intercepted by surface water features or groundwater bodies the impact is potentially regional depending in the environmental circumstances. Therefore, throughout this report references will be made to **Chapter 9: Hydrology and Hydrogeology,** for further detail and clarification on potential effects and mitigation measures of the Project.

### 8.2.2 Relevant Legislation and Guidance

This assessment complies with the EIA 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, and
- Heritage Act 1995, as amended.

The Cork County Development Plan (2022-2028) and Kerry County Development Plan (2022-2028) were 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) (2022) Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (supersedes 1997 and 2002 versions.)
- 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.
- NRA (2014) Guidelines for the Management of Waste from National Road Construction Projects
- 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

Desk top study assessments were undertaken (2020-2023) on the soils and geology aspects of the Project before and after field investigations. This involved the following components:

- Acquire and compile all available maps of the Project, November 2022.
- Study and assess the proposed locations of turbines, Site Access Roads relative to available data on Site topography and slope gradients, November 2022.
- 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, November 2022 – March 2023.
- Overlay Ordnance Survey of Ireland (OSI) 1:250,000, 1:50,000 and 1:10,560 (6") maps with AutoCAD plan drawings, November 2022.
- 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, November 2022.
- Overlay Geological Survey of Ireland (GSI) Groundwater Resources (Aquifers), Groundwater Vulnerability, and Groundwater Recharge maps to determine Site sensitivity in terms of groundwater, November 2022.

- Overlay Geological Survey of Ireland (GSI) Landslide Susceptibility maps to determine Site landslide susceptibility risk classification, November 2022.
- 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, November 2022.
- Search of the GSI databases and publications in relation to geological extractive resources and mineral localities in the region, November 2022.
- Search of the GSI landslide database for records of landslide mass movement events at and near the study area, November 2022.
- Search of the GSI karst database for records of karst features at and near the study area, November 2022.
- Search of the GSI wells and springs database for records of wells or springs at and near the study area, November 2022.
- Search of National Parks and Wildlife Service designated sites in the region, November 2022.

### 8.2.4 Field Work

#### *8.2.4.1 Field Work Preliminary Geotechnical Investigations, Site Walk Over and Observations*

EIA team personnel (Sven Klinkenbergh – Project Manager), carried out field investigations at the Site of the Project between January and February 2019, as well as September 2020 and November 2022. These works consisted of the following:

- Bedrock and mineral subsoil outcrop logging and characterisation.
- Confirm if peat is present at or near any Project 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.
- Borehole 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.[1] 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. [2]

**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. [3]

**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. 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**. |

[1] Environmental Protection Agency (EPA) (2022) Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (supersedes 1997 and 2002 versions)
[2] NRA (2008) Environmental Impact Assessment of National Road Schemes – A Practical Guide – Rev 1
[3] Scottish National Heritage (SNH) (2013) A handbook on environmental impact assessment

#### 8.2.5.2 Magnitude

The magnitude of potential impacts arising as a product of the Project are defined in accordance with the criteria provided by the EPA, as presented in the following table. [4]

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

| Magnitude of Impact | Description |
|---|---|
| Imperceptible | An effect capable of measurement but without significant consequences. |
| Not Significant | An effect which causes noticeable changes in the character of the environment but without significant consequences. |
| Slight Effects | An effect which causes noticeable changes in the character of the environment without affecting its sensitivities. |
| Moderate Effects | An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends. |
| Significant Effects | An effect which, by its character, magnitude, duration or intensity, alters a sensitive aspect of the environment. |
| Very Significant Effects | An effect which, by its character, magnitude, duration or intensity, significantly alters most of a sensitive aspect of the environment. |
| Profound | An effect which obliterates sensitive characteristics. |

In terms of soils and geology, magnitude is qualified in line with relevant guidance, as presented in **Table 8.4**. [5]

**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. |
| 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. |

[4] Environmental Protection Agency (EPA) (2022) Guidelines on the information to be contained in Environmental Impact Assessment Reports
[5] NRA (2008) Environmental Impact Assessment of National Road Schemes – A Practical Guide – Rev 1

### *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 below.[6] 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 Project 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 Project. This is largely driven by the likely far reaching impact which is characteristic of potential effects arising as a product of the Project in terms of the Geological and Soil environment. Far reaching impacts in terms of geology include impacts on the receiving surface water or groundwater bodies where impacts can occur downstream of the site, including at a catchment scale (**EIAR Chapter 9: Hydrology & 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 Consultation*

A full list of scoping responses is set out in **Appendix 1.1: Consultation Responses**. A Scoping Report Consultation was made to Inland Fisheries Ireland in November 2020 in regards to contaminated site run-off and subsequent polluting of surface waters. Consultations were also undertaken at the same time with the Geological Survey Ireland in relation to geohazards and peat stability. Proposed mitigation measures in response to these potentials impacts are outlined in **Section 8.5** of this Chapter.

[6] NRA (2008) Environmental Impact Assessment of National Road Schemes – A Practical Guide – Rev 1

## 8.3 BASELINE DESCRIPTION

### 8.3.1 Introduction

An investigation of the existing land, soils and geology characteristics of the Study Area was conducted by undertaking a desk study (as set out in **Section 8.3),** consultation with relevant authorities(as set out in **Appendix 1.1** and **Section 8.2.5.2),** and Site-based fieldwork surveys(as set out in **Section 8.6**). All data collected has been interpreted to establish the baseline conditions within the Study Area and the significance of potential adverse effects have been assessed. These elements are discussed in detail in the following sections.

### 8.3.2 Site Description

The Site is located 5.9 km west of Ballyvourney, Co. Cork and shares the county boundary between Cork and Kerry. It is 54 km west of Cork City, and 23 km north-east of Kenmare, Co. Kerry. The Project is located within the townlands of Inchamore, Mileeny Derryreag and Derreenaling. The Site is characterised by relatively complex (hilly) topography with associated elevations ranging between 460 metres Above Ordnance Datum (m AOD) in the north-western side of the Site to 350 m AOD towards the eastern side of the Site. The Project is in contrast to on-going Site practices. The Site is characterised as being rural agricultural land generally, however there are a number of established wind farms in the region including Coomagearlahy Wind Farm, Coolknoohil Kilgarvan Wind Farm, Glanlee Wind Farm and Grousemount Wind Farm c. 2.7 km, 4.4 km 4.9 km, and 7.5 km southwest of the Site, respectively (**Appendix 2.3: Wind Farms within 20 km of Proposed Turbines**).

The Site extends to approximately 170 ha of which (c. 145.4 ha) largely consists of low yielding, commercial forestry owned by Coillte. The remaining land (24.6 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.

### 8.3.3 Land Use

Mapped land uses for the Wind Farm, Underground Cable Route and Turbine Delivery Route are presented in **Figure 8.2 a-b.**Error! Reference source not found.

Consultation with Corine (2018) Land Use maps (EPA) determined that the Site is mainly comprised of combination of '*Coniferous forests'* and '*Transitional woodland scrub'*. The Site is otherwise comprised of '*Land principally occupied by agriculture with significant areas of natural vegetation'* and '*Peat bogs'*. While the Site is principally used for commercial forestry along with areas of peat bogs, these spaces have been noted as being 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**.

The Grid Connection Route traverses land principally classified as '*Forest and semi-natural areas'* along with '*Land principally occupied by agriculture and areas of natural vegetation',* within the Site redline boundary (c. 1.3 km). The remaining 18.6 km is located off-road and in third-party lands mapped as '*Conifer forests',* **(Figure 8.2b)** (Corine, 2018).

The Turbine Delivery Route from its origin in Ringaskiddy Port to the Project site crosses countless land uses, including: seaports, industrial and commercial units and discontinuous urban fabric near Cork city and transitions to pastures, arable land, stream courses, heterogeneous agricultural areas, coniferous forests and woodland scrub upon nearing the Project site.

### 8.3.4 Bedrock Geology

Mapped geology is presented in **Figure 8.3 (a).**Error! Reference source not found.

The mapped (GSI, Bedrock 100 k[7]) geological formation underlying the Site is classified as the Gun Point Formation (DUGNPT) – which is comprised of Green-grey sandstone & Purple siltstone.

Ranges of unconfined compressive strength of rock[8]:

- 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).

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 a number of recorded faults associated with the underlying geological formation, however none of these faults are mapped as underlying the redline boundary of the Site.

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

Similarly, there are several strikes and dips of structural bedding with 'way up unknown'. Consultation with GSI Geotechnical database indicates there is no available data for the underlying formations or in the general area of the Project.

Site investigation data, including drill logs are presented in **Appendix 8.1 IWF SI Report - Stability and Geotechnical Assessment.** Summary of bedrock data taken from **Appendix F 3188-A1 IWF SI – Borehole Log** is presented in **Table 8.6**. It is noted that the bedrock underlying the Site (Siltstone) is comprised by mainly silt sized particles (0.002 - 0.063 mm) (BS 5930).

**Table 8.6: Summary Borehole Data**

| Parameter | (Ref. / Unit) | BH01 |
|---|---|---|
| **Geology** | *Drill Log* | Red moderately weak SILTSTONE |
| **Weathering** | *Drill Log* | Relatively unweathered |
| **UCS Results** | *Kn* | 56.7 |
| **UCS Results** | *MPa* | 12.57 |
| **Rock Strength (UCS MPa)** | *BS EN ISO 14689* | Weak |

### 8.3.5 Seismic Activity

The island of Ireland does experience, monitor and record seismic activity, although the magnitude of such occurrences is 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 on or near the mainland of Ireland include:

- An M2.4 earthquake which occurred on 07/04/19, the epicentre for which was located within Donegal Bay, and at a depth of 4 km.
- An M2.0 earthquake which occurred on 29/04/19, the epicentre for which was located approximately midway between Donegal Town and Lough Derg, and at 16 km depth.
- An M0.9 earthquake that occurred 20/08/21, the epicentre of which was located near the townlands of Lambstown at a depth of 8 km.

Although earthquakes are considered a triggering mechanism for landslides, given the low magnitude experienced in Ireland earthquakes are not considered an important triggering factor in terms of stability risks.[9]

### 8.3.6 Soils and Subsoils

Consultation with available soil maps (SIS, EPA, Teagasc) indicate the primary soil type across the Site is that of 'Blanket Peat' while smaller areas of the Site are classified as 'Peaty Gleys - Acid Poorly Drained Mineral Soils with Peaty Topsoil'; 'Acid Brown Earths / Brown Podzolics - Acid Deep Well Drained Mineral'; and 'Podzols (Peaty), Lithosols, Peats with some outcropping rock – Acid Shallow, lithosolic or podzolic type soils potentially with peaty topsoil' (**Figure 8.4a)**.

Consultation with available subsoil maps (GSI) indicate that subsoil types across the Site include mainly 'Blanket Peat' with small-scale portions of Sandstone Till and areas of Bedrock at or near the surface (**Figure 8.5a)**. Soils and subsoils across the entire Grid Connection Route are those of Blanket Peat, **Figure 8.4b** and **Figure 8.5b.** The Turbine Delivery Route traverses various soil types from the port in Ringaskiddy, however where works will be carried out **(Figure 8.4a Figure 8.5a),** soils and subsoils have been mapped as 'Blanket Peat'.

Several rocky outcrops have been mapped by the GSI, particularly at higher elevations - i.e., the north-western corner of the Site boundary and along the norther and eastern boundary of the Site. Furthermore, many minor rocky outcrops were also observed across the Site during Site walkovers. Thin peat and exposed rock were observed at existing cut and fill locations, in particular along the existing Site Access Roads associated with agricultural and forestry practices in the area **(Appendix 9.2 -** Error! Reference source not found.**IWF 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.

[9] 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.*

**Table 8.7: Reported Subsoil Description (Appendix G 3188-A1 IWF SI- Subsoils Lab Certs).**

| Sample ID | Reported Description (PSD) |
|---|---|
| **TP03-A2 (SS1)** | Very clayey very sandy GRAVEL |
| **TP08-A2 (SS1)** | Slightly sandy gravelly CLAY |
| **TP11-A2 (SS1)** | Very 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 (150 No.) range from 0.00 m to >3.00 m. Peat depths were generally shallow. Isolated minor areas of moderately deep peat were observed at some locations, particularly in the northwest corner of the Site near the proposed location of T1.

Peat depths have been mapped by category (**Table 8.9**) and presented in **Appendix A.** Certain peat depths are associated with particular hazards and constraining characteristics in terms of infrastructure construction methodology. Peat depth of 2.0 m or greater is considered '*deep'* or '*deeper*' peat, and in extensive areas of peat which is >2.0 m depth excavation and construction activities become greatly more complicated and present greater risk.

**Table 8.8: Peat Depth Distribution by Peat Depth Category (Appendix A-1 to A-5: 3188-A1 IWF SI - Peat Depth)**

| Peat Depth Category | No. | % |
|---|---|---|
| **A - Rock (0.00 - 0.01 m)** | 16 | 11% |
| **B - Very Shallow (0.01 - 0.5 m)** | 80 | 53% |
| **C - Shallow (0.5 - 2.0 m)** | 42 | 28% |
| **D - Moderately Deep (2.0 - 3.5 m)** | 11 | 7% |
| **E - Deep (3.5 - 5.0 m)** | 1 | 1% |
| **F - Very Deep (>5.0 m)** | 0 | 0% |
| ***Total*** | 150 | |

### 8.3.7 Geological Resource Importance

Consultation with available maps (GSI) indicates that there are no recorded 'Geoheritage' sites located within the redline boundary of the Site or within the near vicinity. Furthermore, the GSI database does not indicate any Mineral Localities or Quarries within or near the vicinity of the Site.

### 8.3.8 Landslide Susceptibility

Peat, subsoil and slope stability assessments for the Site including the Wind Farm and Underground Cable Route are presented in **Figures 8.6 (a - b) Landslide Risk and Events**. The majority of the Turbine Delivery Route (TDR), traverses existing national and regional roads and is generally mapped as 'Low' risk to landslide susceptibility. The area of proposed works along the Turbine Delivery Route, involving approximately 1,870 $m^2$ of upgrading off the N22, is mapped over areas of 'Moderately High' and 'Moderately Low' Landslide susceptibility as mapped by the GSI (2023) (**Figure 8.6a**).

Geo-Hazards in relation to the Project are detailed in **Appendix 8.1** and presented in **Appendix 8.1 - Appendix H (a - c) as well as Figure 8.7.** Conclusions are summarised in the following sections.

### 8.3.9 Peat Slide Risk Assessment

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 areas of deeper peat delineated by shallow subsoils and/or bedrock at or near the surface (**Appendix A of Appendix 8.1**). There was no very deep peat observed at the Site (>5.0 m). Considering this, there remains a residual risk at the Site, it is also important to distinguish between types of landslides, 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 depth of peat at the Site. However, the Site also possesses a degree of elevated risk in terms of subsoil stability . Subsoil, or till landslide events are generally characterised as relatively isolated, see **Plate 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.

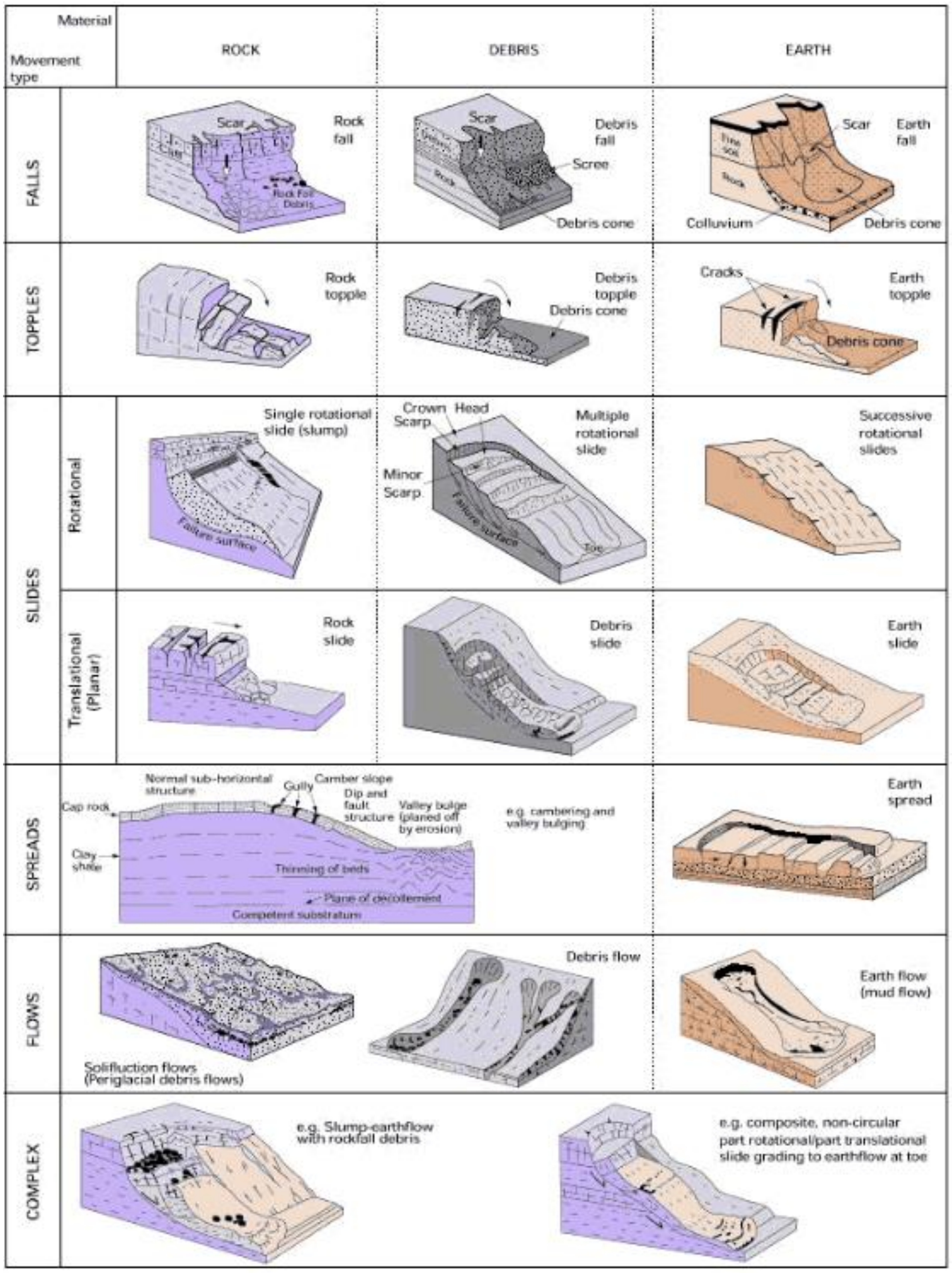


**Plate 1: Illustration classifying types of landslides. Image from Razin, 2012.[10]**

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

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

(**Appendix 8.1, Section 2.2.5**) 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., +1 m 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 (within a receptor buffer zone) to sensitive receptors.

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

Factor of Safety (FoS) at all trial pit locations are 'Acceptable'. Note: Trial pit locations are limited relative to extent of Project 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)**. The term "Inferred" which accompanies 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**). This is in line with the interpretation of survey and available site investigation (SI) data, particularly in preliminary SI phases (**Appendix 8.1**).

### 8.3.10 Subsoil Slide Risk Assessment

With reference to **Appendix 8.1, Table 15 and Table16** and **Appendix 8.1 – App B Peat Database,** subsoils underlying the Site are characterized generally as 'Clayey, silty, sandy, GRAVEL (or TILL) with cobbles and boulders'.

The Factor of Safety (Adjusted) (Scenario B i.e., 1 m surcharge) at trial pit locations is generally 'Acceptable' with two recorded marginally stable point locations at TP04 near the proposed location of T4, and TP11 near the proposed location of T2, **Plate 7 – Appendix 8.1.**

The Risk Ranking (Distance) (Scenario B i.e., 1 m surcharge) at trial pit locations is generally Very Low to Low with the exception of two Moderate risk point locations at TP10 and TP11, near the proposed location of T2, **Plate 7 – Appendix 8.1.**

Refer to **Appendix 8.1 – Stability & Geotechnical Assessment – Section 4** for full risk assessment results. **SI Appendix H (a – c),** 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.[11] [12]

### 8.3.11 Designated & Protected Areas

The Project is not within any designated or protected areas **(Figure 9.11a**). 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 potential impact of the Project covered under **EIAR Chapter 9: Hydrology and Hydrology.** Stockpiling of material along the proposed Grid Connection Route will require particular attention in terms of the placement and management of runoff and construction water, as the route runs parallel to the designated Natural Heritage Areas (NHA) and Special Areas of Conservation (SAC) of Killarney National Park, approximately 40 m from proposed works in some areas (**Figure 9.11b**).

## 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 8.3.5**). The Grid Connection Route (GCR) and Turbine Delivery Route (TDR) are similar; however, these features generally follow existing or proposed roads / tracks.

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[11] Teagasc (1982) "Some Relationships of Drainage Problems in Ireland to Solid and Glacial Geology, Geomorphology and Soil Types", *The Agriculture and Food Development Authority*.
[12] 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.

With reference to **Section 8.2.5** of this report and as summarised in **Table 8.9: Weighted Rating of Significant Environmental Impacts – Within the Footprint of the Site**, the geological attributes within the Site are considered to be of **Low to Medium Importance** and **Low to Medium Sensitivity**, and therefore classification of any potential impacts associated with the Project 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 8.9: 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 Site, and therefore scale is relative to the area of the Site itself. That is, the area of the Site is approximately 170 ha, and the area of the footprint of the Development is approximately 31 ha(approximately 17.1%) of the area of the Site. This means that the land take associated with the Project is considered a negative, Moderate Adverse magnitude (Moderate (15- 50% area) impact on attribute with Medium importance), localised impact of the Project.

### 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 9.2)** including agricultural (pastures, extensive drainage) and commercial afforestation activities (**Section 8.4).**

- 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 Site appears to be the 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 Project 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 Typical Sequence of Events in Wind Farm Construction on the Receiving Environment*

The following sections outline and summarise the general stages and elements of construction related to the Project. Detailed assessment of effects follow in the subsequent headings.

##### 8.4.3.1.1 Activities – Premitigation

1. Site Investigation

2. Site Preparation:
   - Install Surface Water Monitoring Equipment.
   - Install Silt Screens, Interceptor Drains, and SuDS.
   - Prepare construction areas for compounds and facilities.
   - Clear Vegetation and Topsoil.
   - Excavate and grade the area for the construction of access tracks, hardstand areas, foundations, and other significant infrastructure units.

3. Access Track and Hardstand Areas:
   - Install silt screens, interceptor drains, and SuDS
   - Clear vegetation and excavate topsoil, subsoil, and bedrock.
   - Temporarily stockpile arisings.
   - Install drainage structures and erosion control measures, such as culverts and SuDS
   - Construct the road base and hardstand using suitable materials, such as crushed rock or concrete.
   - Construct hardstand areas for the installation and maintenance of wind turbines.
   - Use designated temporary stockpile areas and segregation of materials for different types of material, including materials arising at the Site, and being imported to the Site.

4. Drainage & Sustainable Drainage Systems (SuDS):
   - Install drainage and Sustainable Drainage Systems (SuDS)
   - SuDS maintenance, including during construction phase.

5. Watercourse crossings and culverts:
   - Design and plan the culvert to meet the required hydraulic capacity and align with the watercourse's natural flow pattern.
   - Install silt screens and sediment traps upstream of the construction area to intercept, manage, and divert runoff, reduce entrainment of solids and capture sediment, and prevent it from entering the watercourse.
   - Excavate the area for the culvert installation.
   - Construct the culvert.
   - Backfill the area around the culvert
   - Install headwalls or other associated infrastructure.
   - Restore the natural watercourse flow.

6. Clear Span Bridges:
   - Design and plan the clear span bridge to meet the required hydraulic capacity and align with the watercourse's natural flow pattern.
   - Prepare the area for the bridge construction.
   - Construct the bridge abutments and piers using suitable materials.
   - Install the bridge beams or arches using suitable materials.
   - Backfill the areas around the abutments and piers with suitable materials.
   - Restore the area.

7. Foundations:
   - Excavate and Backfill: To construct the wind turbine foundation, the area will be excavated to the required depth and diameter. Turbine foundation locations will be excavated to dimensions: 2.8 m to 3.2 m depth, 22 m to 25.5 m diameter The area around and above the Turbine Foundation will be backfilled with compacted stone or crushed rock.
   - Form and Pour Foundation: Shuttering and membranes are used to form the foundation pour structure, and foundation reinforcement steel rebar is installed and formed. Concrete is then poured into the foundation structure.

8. Other Significant Infrastructure Units:
    - Construct Infrastructure Units: Other significant infrastructure units, such as substation buildings, electrical cabling, and meteorological masts, will be constructed using suitable materials such as concrete or steel. Temporary infrastructure units such as temporary stockpile areas are also included here.
    - Install Drainage Structures and Erosion Control Measures: As with access track and hardstand areas, drainage structures and erosion control measures such as culverts and erosion control blankets will be installed for other significant infrastructure units.

9. Site Restoration:
    - Backfilling: Excavation areas, such as those where wind turbine foundations were installed, will be backfilled with suitable materials.
    - Soil and Vegetation: Topsoil that was removed during the Site preparation phase will be redistributed.
    - Waste Management: Waste arising from construction activities, including general construction waste and/or excess soils will be removed from site to a licenced waste management facility. The nearest licenced waste facility is over 20 km south-east of the Site in Codrum, Macroom, Co. Cork (Civic Amenity Services).

#### *8.4.3.2 Land Take*

Land take will be required during the construction and operation of the wind farm. This will be required for the construction of site access roads, turbine foundations, the onsite substation and the meteorological mast. Temporary land take will be required to facilitate the laying of grid connection cable ducting both on and off the Site. Long-term land take associated with the Wind Farm Development are covered in **Section 8.5.4 Operational Phase Potential Effects**.

##### *8.4.3.2.1 Land Take Turbine Delivery Route*

Land take will be required for the Turbine Delivery Route, although a majority of the Turbine Delivery Route will traverse already existing roadways (i.e., existing access tracks, public and local road networks from Ringaskiddy.

Works are required for road strengthening and widening along the Turbine Delivery Route at the existing forest road off the N22 and the temporary access road off the N22 to facilitate a 180-degree turning manoeuvre. Typical widening and strengthening work generally involve digging out road verges to c. 0.4 m and replacing them with compact stone to support heavy plant machinery. Topsoil will be used to dress the top of stone upon completion of construction deliveries.

Considering the scale of disturbance (relatively small area and shallow excavation along with superficial paving) at the N22 turning point location and Site Entrance, the effect is considered to be **small-scaled, direct, adverse, slight, localised, and permanent but reversible.** The probability of this effect occurring is **unavoidable** during the construction phase but conforms to baseline conditions e.g. existing public roads. With appropriate mitigation measures, planning and management this effect and disturbance can be minimised.

Land take associated with the Turbine Delivery Route and Grid Connection Route will be limited to the Construction Phase of the Project.

#### *8.4.3.2.2 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, totalling 19.9 km. The proposed grid route will follow the old route of the N22 before following forestry tracks to the existing Ballyvouskill Substation. Any potential effects are described similarly to general land take, however considering the small scale of disturbance, shallow cable trench (c. 1.22 mbGL by 600 mm wide), the effect is considered to be **small-scaled, direct, adverse, localised, permanent but reversible and slight**. The probability of this effect occurring is **unavoidable** during the construction phase but conforms to Baseline conditions e.g., existing public roads and services. With appropriate mitigation measures, planning and management this effect and disturbance can be minimised.

### *8.4.3.3 Clear Fell of Afforested Areas*

Felling of forestry at the Site will be necessary for areas of the Project in afforested sections within the Redline Boundary. This is an **unavoidable** consequence of the Project during the construction phase. The Site contains 145.4 ha of commercial forestry. Turbines T2, T3, T4 and T5 are within afforested areas. Subsequently, tree felling will be required as part of the Project To facilitate the construction of access roads, civil works, site compounds, borrow pits and Turbine Hardstands, 25.68 ha coniferous forestry will need to be clear-felled. The likely felled area of approximately 25.68 ha will represent approximately 15.11% of the proposed Site area (170 ha). In a spatial or land use context this is considered a **slight** to **moderate** scale impact, limited to the extent of the Project footprint and turbine buffer felling zones.

The clear fell of afforested areas is **in line with baseline conditions** and future activities as part of Do-Nothing impact. Therefore, in the context of the Project, the clear fell of forestry overall is considered **neutral**, however there is a range of potential **direct**, **adverse** impacts associated with the activity which will require management and mitigation. Potential effects include:

1. Soil erosion, compaction and degradation: The removal of trees and underbrush during clear-felling can expose soils to wind and water erosion, leading to soil loss, compaction and degradation. This is mainly caused by vehicular movements (**Section 8.4.3.8 Vehicular Movements**).
2. Geology: Clear-felling can cause changes in the geology of an area, leading to soil instability, landslides, and other geological hazards (**Section 8.4.3.6 Ground Stability** .
3. Hydrology & Hydrogeology: The removal of trees and vegetation can lead to changes in hydrological processes, causing changes in water flow rates and patterns, such as the lowering of water tables (**Chapter 9: Hydrology and Hydrogeology)**.
4. Water quality: Clear-felling can cause increased sediment runoff and nutrient pollution in waterways, which can impact water quality, negatively affecting aquatic ecosystems and downstream water users.
5. Soil nutrient loss and nutrient loading of receiving waters: Clear-felling removes vegetation and leaves soil bare, exposing it to weathering, which can cause the entrainment of solids and/or the loss of soil nutrients, essential for plant growth. This in turn will lead to an increase in nutrients i.e., Nitrogen and Phosphorous compounds, dissolved organic carbon, potassium etc. in receiving waters flowing from the Site, which is considered a negative impact of the Project (this is discussed in greater detail in **Chapter 9: Hydrology and Hydrogeology**).

| | |
|---|---|
| **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. |

| | |
|---|---|
| | • Compaction of soils, potentially reducing recharge capacity etc. |
| **Receptor/s:** | • Soil and subsoil structure and lithology. |
| | • Surface Water. Surface water quality, ecological sensitivities and WFD status. |

The overall potential effects here are considered to be of **moderate** significance**, permanent but reversible**, and **adverse**, though this is of a minor scale in comparison to the normal forestry activities taking place at the Site (i.e., small-scale felling proposed). If the Project 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 Project. Therefore, the resulting incremental felling of the afforested area will benefit the receiving environment, namely the receiving surface water network by means of reducing the potential magnitude of impacts, namely erosion, solids entrainment, and shock nutrient and sediment loading. With appropriate mitigation measures, planning and management this effect and disturbance can be minimised.

#### *8.4.3.4 Subsoil and Bedrock Removal*

Subsoil and bedrock removal will occur during construction excavations and is an **unavoidable** consequence of the Project for turbine bases or other foundations, as well as the removal of bedrock material from the Site borrow pit. Removal of the soil and bedrock is considered to be a **permanent** effect if breaking into competent bedrock.

The removal of soils and bedrock 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. No further subsoil or bedrock removal will be required during operation. However, to note this effect conforms to baseline conditions in terms of the development of forestry track operations.

The amounts of subsoil and bedrock to be removed are laid out in construction and excavation plans, specified in **EIAR Chapter 2: Project Description** and **Appendix 2.1: Construction Environmental Management Plan (CEMP), Management Plan 4.** The volume of excavated material which is to be stored in the on-site borrow pit is 81,215 m³ and considered to be **large-scale** when considering the footprint of the Development.

Although there is the potential for **direct**, **adverse, slight to moderate** significance effects on the local geology, there are a number of indirect or secondary effects including the potential for entrainment of suspended solids in runoff and increasing groundwater vulnerability by decreasing the depth to the water table. These effects are discussed further under **EIAR Chapter 9: Hydrology and Hydrogeology.**

Subsoils and weathered bedrock, when segregated and managed, will be reinstated similar to baseline conditions, and therefore effects are **temporary**, however breaking of competent bedrock cannot be reinstated to baseline conditions.

Worst case scenarios include the triggering of a significant localised peat-landslide or mass movement event, a potentially profound if in close proximity to receptors, and permanent adverse impact, refer to **Appendix 8.1: Site Investigation & Stability Risk Assessment Report.**

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.[13] The proposed location of turbines avoids areas with steep to severe inclines. **(Appendix H)**. Nonetheless, 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**: **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. With these applied mitigation measures, planning and management this effect and disturbance can be minimised.

**Mechanism/s:**

- Construction activities; Excavation, handling/transport, temporary storage of soils / subsoils / bedrock, vehicle tracking.
- Erosion in areas impacted by construction activities.
- Erosion in areas with newly formed preferential pathways for water runoff.

[13] 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*.

| | |
|---|---|
| | • 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.<br>• Surface Water. Surface water quality, ecological sensitivities and Water Framework Directive status. |

#### 8.4.3.4.1 Excavations

Excavations will be required for most aspects of the Project including for turbines, Turbine Hardstands, Site Access Roads, works along the turning point (off the N22), temporary construction compound, cable trenches, Met Mast, and Grid Connection Route. Estimates of excavation volumes are presented in **Table 2.5 and Table 2.6 of EIAR Chapter 2: Project Description**.

Increased excavation and peat / soil / subsoil / bedrock removal activity will be concentrated to particular locations of the Project during the construction phase, including the site entrance, load bearing portions of turbine hardstands, turbine foundations, site borrow pit, and works associated with the improvement or construction of watercourse crossings and culverts. All the above combined are considered to be **moderate to large in scale**, however, conforms to baseline conditions at the Site with forestry operations.

The excavation and removal of soils and bedrock to facilitate construction is a **direct, unavoidable, adverse, slight to moderate significance, localised** impact of the Project, and is considered **permanent but reversible,** in instances where reinstatement is proposed (i.e., Borrow pit location). However it is important to note that excavation activities, in particular spoil management / temporary or permanent stockpiles, and vehicular movements can trigger indirect or secondary impacts such as localised stability issues and / or impacts on the receiving surface water or drainage network, leading to a **potentially profound**, and **permanent adverse** impact, refer to **Appendix 8.1 – SI Report, Appendix H (a – c) IWF SI Geo-Hazards,** and **Appendix I (a – c ) Peat and Subsoil Stability Risk Assessments**. These impacts are discussed in the following sections. With appropriate mitigation measures, planning and management this effect and disturbance can be minimised.

#### 8.4.3.4.2 Site Access Roads

Site Access Roads are required to accommodate the construction works and to provide access to the turbine locations for the whole life cycle of the wind farm. According to **Table 2.3** of **EIAR Chapter 2: Project Description**, 3,102 m of the existing Site Access Road will be upgraded during the construction phase, involving widening the roads to cater for larger vehicles and loads. Upgraded Site Access Roads will be approximately 6,203 $m^2$ in surface area and will require approximately 1,400 $m^3$ of crushed stone material.

There will also be 3,555 m of new Site Access Roads required for the Project. These will be constructed to provide a width of 4.5 m and 5.5 m at bends and will cover an area of 15,998 $m^2$ and require 1,700 $m^3$ of crushed rock. In total the construction of Site Access Roads is considered to be **moderate to large scale** effect.

These roads will be excavated to a level where the underlying soil or rock that can bear the weight of traffic without shifting or compressing.  They will be constructed using rock from the on-site borrow pits and capping stone from nearby quarries listed in section. All imported stone to the Site will undergo appropriate quality testing. When weathered, the stone will not contain any constituents which may be harmful to the environment, surface and groundwater in particular. Permeable geotextile will be placed at the base of access tracks, as part of their  design.

The formation of Site Access Roads will have a **slight to moderate**, **adverse, direct**, **permanent but reversible** effect of the Project This effect will be limited to the footprint of the Project and is considered **unavoidable**, while conforming to baseline conditions of forestry operations. With appropriate mitigation measures, planning and management this effect and disturbance can be minimised.

#### 8.4.3.4.3 Turbine Foundations and Turbine Hardstands

The material encountered at each turbine and infrastructure location is considered to be mostly shallow peat overlying bedrock, with some moderately deep peat near the proposed T1 location, **Appendix 8.1 - App A1**. Minor areas of glacial till may also be encountered locally, as presented in **Figure 8.4a**. It is likely that excavations for the majority of infrastructure will be taken down to bedrock; the depth of the excavation required for the Turbine Foundations will range from 2.8 m to 3.2 mbGL).

Excavations will require granular fill material to upfill the excavation to the levels required for construction. It is proposed that the granular fill material will be obtained from the Borrow Pit i.e., maintaining local geo and hydro chemistry. Ground investigations in the form of peat probing and gouge coring has been carried out along the proposed Turbine Hardstand locations to inform the depth of excavation and upfill required. As set out in **Table 2.6** of **EIAR Chapter 2: Project Description,** approximately 7,250 $m^3$ of material will be excavated for turbine foundations. Of this 1,562 $m^3$ will be peat, 3,083 $m^3$ will be subsoils and 2,605 $m^3$ will be bedrock.

Excavated rock will be reused as hardcore at hardstanding areas and Site access tracks. Subsoils facilitate the construction of soil berms and reinstating the Borrow Pit post construction and peat will be used as backfill to foundations and to reinstate the borrow pit post construction.

Any imported material, if necessary, will be fully tested in accordance with industry standards. Only verified clean, inert material will used.

The Temporary Construction Compound and Electrical Sub-Station will measure approximately 9,907 $m^3$ and will require similar foundations to those of Turbine Hardstands. Substation southern portion of the Development. Of this excavated material approximately 1,385 $m^3$ will be peat and 8,522 $m^3$ will be subsoils.

The likely effects associated with excavations at hardstand areas are considered to be **direct**, **slight to moderate, adverse** (in terms of overall project scale), **permanent** (life of project) and **reversible** through reinstatement during the decommissioning phase of the Project. With appropriate mitigation measures, planning and management this effect and disturbance can be minimised.

#### 8.4.3.4.4 Borrow Pit

One borrow pit will be constructed as part of the Project . The proposed borrow pit is located c. 20 m to the east of T5 hardstand and will measure 38,674 $m^2$. The borrow pit will provide 50,276 $m^3$ excavated material to be used as fill for roads, hardstands, backfill for foundations and the temporary compound.

The borrow pit will be excavated only as required to reduce the need to transport material to the Site. Where rock and fill material are available from the excavation of Turbine Foundations this hardcore material will be used first.

The likely effects associated with the removal and replacement of subsoil and bedrock at excavations for the on-site Borrow Pit are considered to be **unavoidable**, **direct, adverse** and **moderate to large** (in terms of overall project scale), **slight to moderate**

**significance, permanent** and **reversible** in terms of geology e.g., replacing competent bedrock, but impacts to ground levels will be **reversible** through reinstatement with fill. This effect is considered to be limited to the footprint of the Project and with appropriate mitigation measures, planning and management the effect and disturbance can be minimised.

#### 8.4.3.4.5 Site Cable Trenches

There will be circa 4,743 m of internal cabling. Cable trenches throughout the Site will be excavated to an anticipated depth of approximately 1.220 mm and will contain the electrical and fibre-optic cables running from the turbines to the substation compound within the Site Roads and/or their verges. Excavation of peat, bedrock and inferred locally glacial till will be required. Granular fill, from the Borrow Pit, will be used to surround the cables, however the majority of the excavated soils will be used for backfilling with the potential for minor amounts being removed and used elsewhere for example, berm landscaping.

The likely effects associated with shallow excavations for Site Cable trenches are considered to be **unavoidable**, **direct, adverse** and **small to moderate** (in terms of overall project scale), **slight significance, permanent** (life of project) and **reversible** through reinstatement during the decommissioning phase of the Project. This effect is considered to be limited to the Project and conforms to existing Baseline (e.g., public roads and services). With appropriate mitigation measures, planning and management this effect and disturbance can be minimised.

#### 8.4.3.4.6 Turbine Delivery Route

The Turbine Delivery Route will use existing roadways between Ringaskiddy Port and the Site. Works at an entrance to an existing forest road off the N22 will include the widening of the road and creation of a splayed entrance. Additionally, the construction of a temporary access road off the N22 in the townland of Cummeenavrick to facilitate 180 degrees turning manoeuvre by construction vehicles is also proposed. The Turbine Delivery Route will require an area of upgrading totalling 1,870 $m^2$.

The likely impacts associated with excavations on the Turbine Delivery Route are considered to be relatively **small** in scale, **direct, localised, slight significance**, **adverse**, **long term to permanent** (life of project) and **reversible** through reinstatement during the decommissioning phase of the Project. This effect is considered to be localised and conforms to Baseline (e.g., public roads and services). With appropriate mitigation measures, planning and management this effect and disturbance can be minimised.

#### 8.4.3.4.7 Grid Connection Cable

The overall length of the grid connection between the substation and the existing 220 kV GIS substation is 19.9 km, following the old route of the N22 for a short distance (c.0.469 km) before following forestry tracks to the existing Ballyvouskill Substation. Grid Connection trenches will be excavated along the Grid Connection route, predominantly within tracks and verges, to the Ballyvouskill Substation.

The 38 kV cable trenches will be excavated to an anticipated depth of approximately 1.22 m, and to a width of 0.6 m. Depending on the detailed design and excavation of road aggregates, peat, bedrock and inferred local glacial till will be required. The trenches will be backfilled using granular material. The excavated material will be disposed of offsite as inert landfill at a licenced facility or recycled for use elsewhere.

Joint Bays are pre-cast concrete chambers along the Grid Connection Route where individual lengths of cables will be joined to form one continuous cable. A joint bay is constructed in a pit. Each joint bay will be 6 m long x 2.5 m x 2.3 m deep. A reinforced concreted slab will be constructed on top of the bay.

The impacts associated with excavations for cable trenches are considered to be **unavoidable**, **direct, adverse, moderate** in scale**, slight in significance, permanent** and reversible through reinstatement during the decommissioning phase of the Project **and adverse.** This effect is considered to be localised and conforms to Baseline (e.g., public roads and services). With appropriate mitigation measures, planning and management this effect and disturbance can be minimised.

#### 8.4.3.4.8 Total Volume to be Excavated

Indicative total volumes of material to be excavated are presented in **Table 2.6 of EIAR Chapter 2: Project Description**.

### *8.4.3.5 Storage of Stockpiles*

#### 8.4.3.5.1 Overview

The majority of spoil generated on Site will be peat and subsoils with some rock excavated at Turbine and Sub-Station Foundations.

It is expected that the majority of rock will be reused for the construction of Site Access Tracks and/or Turbine Hardstands.

Material to be temporarily stored for a period during the construction phase will be placed adjacent to excavation areas, at a distance of at least 20 m from any drainage feature. These short-term temporary stockpiles, if located near T1 (i.e., Moderately Deep peat), **Appendix 8.1 – App A – Peat Depth Overview,** will be limited to 1 m in height. This material will be used for later reinstatement of the Borrow Pit.

Once the required rock has been extracted from the borrow pit, it will be reinstated using any surplus inert material from the Site, that way the size of the Temporary Spoil storage areas is minimised. As a worst case, stockpiling of peat can give rise to increased pore pressures and the possibility of a bog burst or peat slide. Careful management of the spoil and ongoing landslide risk assessments will minimise the possibility of a landslide or stability issue occurring.

#### 8.4.3.5.2 Spoil Management

Increased excavation and peat / soil / subsoil / bedrock removal activity will be concentrated to particular locations of the Project, including the site entrance, load bearing portions of turbine hardstands, turbine foundations, site borrow pit, and works associated with the improvement or construction of watercourse crossings and culverts, works along the Turbine Delivery Route and proposed works along the Grid Connection Route.

Therefore, of significance, during the construction phase of the Project, 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 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.

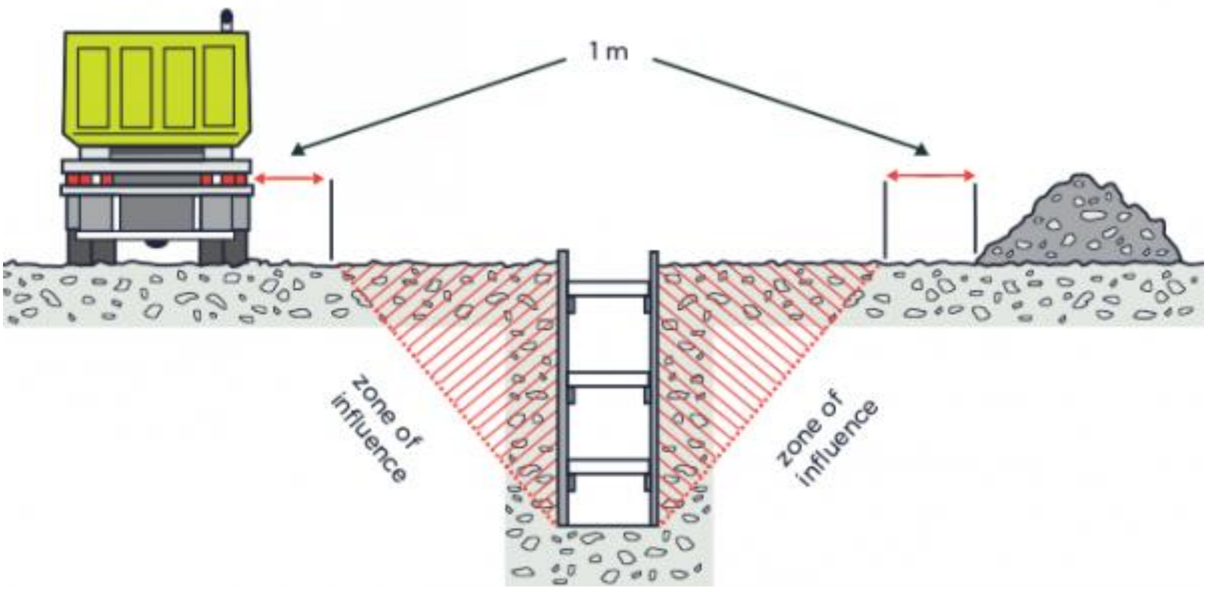


**Plate 2: Examples impact of loading or surcharge on ground in proximity to open excavations.[14]**

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

The handling, management and re-use of excavated materials are of importance during the construction phase of the Project. It is envisaged that excavated material (i.e., soils, subsoils and peat) totalling 81,215 $m^3$ will be used as back fill and for reinstatement purposes, that is reused on site as appropriate, and any surplus material will be transported to the on-site borrow pit for reinstatementt and will be capped to a level of 0.8 m above the existing ground level. The management of the above quantities is considered to be on **moderate to large** in scale. Peat will be stockpiled no higher than 2 m and follow the guidelines and recommendations set out by the National Roads Authority (2014), **Section 8.2**. The reinstatement of the borrow pit has been further detailed in **Chapter 2: Project Description and Appendix 2.1: Construction Environmental Management Plan, Management Plan 4: Peat and Spoil Management Plan**.

With relation to excavated material removed during the Grid Connection network installation, 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.

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

There is potential for a moderate adverse effect on soil due to erosion of inappropriately handled excavated materials. However, any effects from the handling of excavated materials will be managed through good Site practice.

Organic matter loss can occur when wet peat is excavated and allowed to dry in the open air. Peat material is a major source of carbon, and the loss of organic matter leads to an emission source of carbon dioxide (CO2) and nitrogen dioxide (NO2). Furthermore, excavated forestry material can also contribute to Nutrient Enrichment from historical site practices, refer to **EIAR Chapter 9: Hydrology and Hydrogeology.**

The process of spoil management is expected to have a **likely, direct, slight to moderate, adverse** effect of the Project on the receiving environment and is considered **permanent but reversible**. This effect is considered to be restricted to the footprint of the Project but can have indirect / secondary impacts to the surrounding area (i.e., localised extent). This effect conforms to baseline (e.g., forestry operations, public roads and services). With appropriate mitigation measures, planning and management this effect and disturbance can be minimised. Ground stability on a larger scale is discussed further in the following section.

#### 8.4.3.5.3 Peat Stability and Slope Failure

### *8.4.3.6 Ground Stability*

Ground stability, as discussed in the baseline section of this report, is not considered an impact with significant potential under the footprint of the Project, 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 areas of moderately deep peat, high/moderately high risk to landslide susceptibility). Some areas possessing elevated risk on a larger scale within the Project footprint (elevated risk associated with deep till deposits, iron pan and steep inclines; and elevated risk associated with proximity of receptors with varying sensitivity). All proposed turbine hardstand areas are located outside of these elevated risk areas, with the exception of three No. points at T3, and the proposed hardstand area of T5 which unearthed iron pan deposits at TP003, (**Appendix 8.1 – App C).**

The designed Turbine Delivery Route traverses' areas of 'Low' Landslide Susceptibility from the Inchamore Wind Farm to the N22 along the existing third-class road as mapped by GSI (2022), with the exception of the first 1.3 km which traverses moderately high and high risk. The remaining extent of the Turbine Delivery Route, c. 80 km, will utilise pre-existing third-class road infrastructure between the N22 and Ringaskiddy. While this stretch of area varies in degrees of Landslide Susceptibility ('Low' to 'Moderately High'), it is an 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 Turbine Delivery Route.

The entire length of the Grid Connection Route (19.9 km) 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 (1.5 mbGL, with the potential for deeper excavations up to 2.0 mbGL), 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 seven recorded Landslide Events (OBJECTIDs: 7517, 7518, 7519, 7520, 7521, 7524, 8079) within c. 500 m of the northern portion of the Grid Connection Route, documented by GSI (2022). Each landslide event took place north of the route in both coniferous forests and peat bogs with 'No Apparent Impact'. The appointed ontractor will confirm 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 Project 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 Project. This is considered a **likely**, **direct, adverse, slight to profound significance, small to moderate** in scale**, localised (potentially regional), temporary but reversible** impact. This effect is considered to contrast to Baseline. With appropriate mitigation measures, planning and management this effect and disturbance can be minimised.

Potential indirect soil stability issues including downgradient of the Project footprint brought about by construction activities are considered to be **unlikely**, **direct, adverse, significant to profound significance, small to moderate** in scale**, localised (potentially regional), permanent** effect**.** This effect is considered to contrast to baseline. With appropriate mitigation measures, planning and management this effect and disturbance can be minimised.

### *8.4.3.7 Geological Stability*

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 the Onsite Substation and Control Building and borrow pit.

Construction activities can give rise to localised stability issues. Localised stability issues arising during construction activities, namely excavation activities include 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 rivers, 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 Project footprint.

When considering the Grid Connection Route, shallow excavations, (c. 1.3 mbGL along the cabling route and 1.75 mbGL 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 constructed Site Access Tracks (1.3 km) and pre-existing forestry tracks to the existing Ballyvouskill Substation (18.6 km).

Potential geological stability issues brought about by construction activities are considered to be **unlikely**, **direct, adverse, slight significance, small to large** in scale**, localised** and **permanent** effects**.** This effect is considered to contrast to Baseline but with appropriate mitigation measures, planning and management this effect and disturbance can be minimised.

### *8.4.3.8 Vehicular Movements*

#### 8.4.3.8.1 Overview

Vehicle movement will occur primarily during the construction phase of the wind farm. Construction vehicles will include cranes, excavators, dumper trucks, concrete trucks, private cars (construction personnel). During the operation phase, vehicles will be limited to occasional maintenance vehicles only.

#### 8.4.3.8.2 Compact, Erosion and Degradation

Compaction of soils may occur during construction and to a limited extent during operation and Decommissioning. In general, compacted soils will be excavated during construction, and access to soils away from hardstanding areas will be prevented. Ongoing compaction of soils will occur in areas of site access road construction, which will continue during operation and Decommissioning. Compaction effects are considered to be **likely, direct, adverse, slight to moderate significance, moderate to large** in scale**, permanent** and limited to the footprint of the Project. This effect conforms to Baseline (e.g., forestry) and with appropriate mitigation measures, planning and management this effect and disturbance can be minimised.

Erosion and degradation of exposed soils will also occur, primarily during construction, which will potentially lead to loading of runoff with solids and other contaminants. With reference to **Section 8.3.4**, the entrainment of solids in storm or construction water runoff is of particular concern considering the underlying bedrock geology is comprised of (weak) SILTSTONE bedrock, **Appendix 8.1**. Entrainment of soils are further assessed under **EIAR Chapter 9: Hydrology & Hydrogeology.**

#### 8.4.3.8.3 Peat Stability and Slope Failure

As discussed under **Section 8.4.3.4.3** and in the **Appendix 2.1, Management Plan 4:** Peat and Spoil Management Plan, vehicular movements on Site have the potential to trigger soil or slope stability.

#### 8.4.3.8.4 Turbine Delivery Route and Site Access Roads

The delivery and connection routes will utilise existing roadways and infrastructure along the majority of the routes and therefore, the impacts associated with vehicle movements along the Turbine Delivery Route is considered to be **direct, adverse, small** in scale**, not significant to slight, permanent but reversible.** This effect is considered to be localised and conforms to Baseline (e.g., public roads and services) and with appropriate mitigation measures, planning and management this effect and disturbance can be minimised.

#### *8.4.3.9 Soil Contamination*

##### 8.4.3.9.1 Overview

Construction activities associated with the Project 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

Use of waste materials during construction, operation and decommissioning will be minimised by good site practices and waste management plans. The following sections present the possible impacts primarily associated with the use of construction plant.

##### 8.4.3.9.2 Hydrocarbons

Wherever there are vehicles and plant in use, there is the potential for a direct hydro-carbon release which have the capacity to contaminate soils and subsoils. Furthermore, a spill has the potential to indirectly pollute water, if the soil and subsoil act as a pathway from any source of pollution.

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**.

Any accidental contaminant spillage of fuel or oil, depending on the volume, would potentially present a **significant, direct, adverse, small-scale long term to permanent**, effect on the soil and geological environment on the Site, which contrasts to Baseline. However, this potential impact is considered to be **localised** (if contained, **EIAR Chapter 9: Hydrology & Hydrogeology**), naturally **reversible** (natural attenuation over a relatively medium to long term period of time), or immediately 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.

### 8.4.3.9.3 Horizontal Directional Drilling

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, and this or a similar product will be used. 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.

#### 8.4.3.9.3.1 Drill Arisings

Spoil arising from drilling activities will require temporary stockpiling and has the potential to be entrained by surface water runoff (suspended solids). Potential effects involving drill arisings are similar to those outlined in Spoil Management **Section 8.3.4.3.5.2.** For instance, 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.

#### 8.4.3.9.3.2 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.[15]

Potential effects involving drilling fluid returns are similar to those outlined in Hydrocarbon Contamination **Section 8.4.3.9.2.** For instance, drill fluid returns/frack outs 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).

#### 8.4.3.9.3.3 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.

#### 8.4.3.9.3.4 Horizontal Directional Drilling Potential Effects

A worst-case scenario could possibly occur whereby the proposed works of HDD could result in an accidental contaminant spillage with a **likely**, **direct, adverse, slight to moderate, small** in scale **short term** effect on the soil quality of the Site. 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,

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

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. 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.

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 present and baseline description of the underlying bedrock aquifer. There are no karst features associated with the Project.

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

#### 8.4.3.9.4 Wastewater and Sanitation

The Project includes temporary sanitation facilities for site workers during the construction and therefore has the potential to result in the accidental leakage of wastewater or chemicals associated with wastewater sanitation onto soils, and into the drainage network during the construction and operational phases of the project.

Wastewater and wastewater sanitation chemicals are pollutant risks due to their potential impact on the ecological productivity or chemical status of surface water systems, and toxicity to water-based flora and fauna.

The worst-case scenario/s associated with wastewater sanitation is the potential for sanitation chemical, particularly related to porta-loos, accidentally spilling or leaking and being intercepted by surface water drainage features and in turn surface water networks associated with the proposed development.

Potential incidents related to the release of waste and chemicals from wastewater sanitation facilities at the Site will be **likely, direct, adverse, small** in scale**, moderate to significant** effects which contrast to Baseline. This effect is considered to be localised in terms of the soil and geological environment. However, the potential impacts to downstream receptors can be **long term to permanent**. With appropriate environmental engineering controls and mitigation measures these potential impacts can be significantly reduced.

#### 8.4.3.9.5 Construction or Cementitious Materials

The Project will require concrete for the formation of turbine bases, including in locations which are in proximity to receptors e.g., drains and surface waterbodies. This could potentially give rise to or result in the accidental spillage or deposition of construction waste into soils and in turn impact on surface water runoff, or accidental spillages directly intercepted by drainage or surface water networks associated with the Project.

Depending on the chemistry of the material in question, the introduction of such materials can lead to a local change in hydrochemistry and impact on sensitive attributes e.g., ecology. For example, the introduction of cementitious material (concrete / cement / lean mix etc.) can lead to changes in soil and water pH, and increased concentrations of sulphates and other constituents of concrete can further impact water quality. Fresh or wet concrete is a much more significant hazard when compared to set or precast concrete which is considered inert omparisonn, however it is noted that any construction materials or waste deposited, even if inert, is considered contamination.

Surface water runoff, or groundwater coming into contact with concrete will be impacted to a degree, however water percolating through lean mix concrete will be impacted significantly. Therefore, the production / acquisition, transport of material and management of plant machinery must also be considered.

The worst-case impacts associated with a release of wet or lean mix cementitious materials is considered to be potentially **likely**, **localised**, **direct, adverse, slight to significant, small** in scale**, long-term to permanent** effect, particularly in terms of potential indirect or secondary effects on the receiving surface water system. The use of cementitious material is in contrast to Baseline conditions at the Site. With appropriate environmental engineering controls and measures, this potential risk can be significantly reduced.

#### 8.4.3.9.6 General Waste

The construction phase of the Project has the potential to generate excess general wastes from construction personnel such as organic food waste, plastics (bottles and/or packaging), metals (aluminium cans and/or tins) and cardboard waste (Tetra Pak cartons, newspaper, wastepaper). This is a **likely** effect of theProject, but every effort will be made to ensure that every piece of general waste will be disposed of properly and removed from Site. The impacts associated with waste materials is considered to be **direct, adverse, slight significance, small** in scale**, localised, long term to permanent** effect which contrasts to Baseline**.** With appropriate environmental engineering controls and measures, this potential risk can be significantly reduced.

### 8.4.4 Operational Phase Potential Effects

#### *8.4.4.1 Land Take Wind farm*

Land take will be required during the construction and operation of the wind farm. This will be required for construction of Site Access Roads, Turbine Foundations, Onsite Substation, Met Mast and for temporary land take the facilitate the laying of grid connection cable ducting both on and off the Site.

Land take is a Moderate (Site footprint = 28.79 ha, Site area = c. 167 ha, land take equates to 17.24% relative to the scale of the Site) direct impact of the Project, that is land being used as forestry and agricultural pastures currently will be replaced by the Project. The extent of land take will correlate with the footprint of the Project 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 footprint required for safe excavation practices (e.g., batter back, discussed in the following sections).

Excavation, deposition and ground sealing activities associated with land take required for the Project will lead to disturbance of otherwise generally greenfield, undisturbed land, in the absence of commercial forestry practices, that is, the natural soil profile, important for the purpose of facilitating current land use practices, namely forestry and agriculture, will be directly affected under the footprint of the Project.

The overall potential effects here are considered to be of **unavoidable, direct, adverse, slight to moderate significance and scale, long term to permanent** (life of project), but **reversable** through the decommissioning and restoration phase of the Project. This effect is considered to be limited to the footprint of the Project and conforms to baseline (e.g., forestry operations). With appropriate mitigation measures, planning and management this impact can be reversed, and disturbance minimised.

Land take associated with the Turbine Delivery Route and Grid Connection Route will be limited to the Construction Phase of the Project **Section 8.4.3.2**.

### 8.4.5 Decommissioning Phase Potential Effects

In general, the potential effects associated with decommissioning will be similar to those associated with construction but of reduced magnitude because extensive excavation, and wet concrete handling will not be required. The potential environmental effect of soil storage and stockpiling and contamination by fuel leaks will remain during decommissioning.

On the basis that a Decommissioning plan has been established, **Appendix 2.1**, and will be implemented during the Decommissioning works associated with the Project, potential issues arising giving cause to residual impacts are likely to be **infrequent**, **imperceptible** to **slight, direct, adverse, localised** and **reversible**.

## 8.5 MITIGATION MEASURES AND RESIDUAL EFFECTS

This section of the chapter outlines the main mitigation measures which will be applied to the wind farm in order to reduce the effects of the impacts outlined previously.

### 8.5.1 Design Phase

#### *8.5.1.1 Mitigation by Avoidance*

The opportunity to mitigate any effect is greatest at the design phase. In this respect, a detailed Site selection process was carried out by the design team. A process of "mitigation by avoidance" was undertaken by the EIA team during the design of the turbine and associated infrastructure layout.

- At the start of project commencement, indicative turbine locations were issued, and through a desktop assessment the most significant environment constraints (in the context of land, soils and geology and sensitive receptors) were identified on a constraints map.
- From this a new layout was issued, during the detailed design stage. With the new layout iteration, peat probing was then carried out on Site. Once peat data was processed a further constraints map produced and issue to the Client.
- Off the back of this, an additional turbine layout iteration was issued avoiding all the sensitivities highlighted.

Arising from the results of this study, a constraints map was produced that identifies areas where geotechnical constraints (deep peat, steep inclines and shallow bedrock) could make parts of the Site less suitable for development. Furthermore, within the chosen Site, areas of deep peat and shallow bedrock were identified, and the infrastructure design sought to avoid those areas as much as possible. The layout plan was reviewed and the most appropriate design available for protecting the Site's existing geotechnical (and hydrological) regime was identified, whilst avoiding other environmental constraints. The Geo-Hazard constraints are assessed and presented in **Appendix 8.1 – IWF 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 to be either localised (i.e., land take and soil and subsoils removal for the Grid Connection Route, Turbine Delivery Route or stability risks) or within the development footprint (i.e., land take for the wind farm, clear felling of forestry, soils compaction and vehicular movements). Therefore, impacts assessed and classified in the following section/s are considered at the localised scale, **Table 8.11,** including the potential indirect impacts on downgradient receptors, for example associated with surface water as introduce in **Section 8.2.1.1.**

#### *8.5.2.1 Felling of Afforested Areas*

Best practice 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 and other sensitive environmental attributes.

Proposed mitigation measures regarding the management of forestry operations are described below,

- Phased felling approach (**Chapter 2: Project Description**, Section 2.3.2),
- Minimise erosion by using existing tracks and use of brash for off track areas,
- The following forestry guidance and policies;
  - 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
- Maintaining a 25 m (minimum) buffer at felling locations near surface water receptors, for instance at the proposed location of T2, T4 and along Site Access Roads near the prosed location of Watercourse Crossing 3 (WC3).

Proposed mitigation measures outlined above, i.e., phased felling approaches will lessen impacts to the surrounding landscape and important surface water receptors by limiting the amount of soils, vehicular movements, soil compaction, etc. introduced to the Site at one time. This in turn can be seen as a **direct**, **slight to beneficial** effect.

### *8.5.2.2 Subsoil and Bedrock Removal*

The removal of peat and mineral subsoil / bedrock is an unavoidable impact of the Project, 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. The impacts associated with this removal will be minimised using the following practices.

#### 8.5.2.2.1 Mitigation by Good Practices

Best practice will be applied during construction which will minimise the amount of soil and rock excavation. All works will be managed and carried out in accordance with the Construction Environmental Management Plan (CEMP), which will be updated by the civil engineering contractor in accordance with the conditions of any permission granted and agreed prior to any works commencing on Site.

Excavation of peat in areas where there is >1.0 m in peat depth, for instance at T1, T3 and T5 (**Appendix 8.1 – App A**) 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 of 'Moderately Deep' peat, mainly at the proposed location of T1, **Appendix 8.1: App A**.

In those parts of the Site where excavation will intercept areas of peat that are >1.0 m depth (proposed locations T1, T3 and T5), 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. 10 m horizontal distance if excavating to 2.5 m 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 (>2.0 m), particularly at proposed location of T1, excavation supports will be used, 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),** proposed hardstand areas have avoided these areas of deep peat. 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 **Error! Reference source not found.**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 [17].

**Table 8.10: Critical Angle of Repose for Various Soil Types [18]**

| Soil Type | Critical Angle of Repose (Degrees) | | |
|---|---|---|---|
| | Dry | Moist | Wet |
| Topsoil (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 | |

[17] 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
[18] 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 (Loose)** | 35-45 | |
| **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 (>1.0 m peat depth) areas will ensure that any excavations associated with the Project 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.

#### 8.5.2.2.2 Mitigation by Reuse

Bedrock will be re-used for construction of Site Access Tracks and/or Turbine Hardstands wherever possible. The bedrock will comprise predominantly sandstone and siltstone which, when crushed and graded, will provide a good sub-base for Site Access Track construction.

Similarly, the subsoil (GRAVELS) or till at the Site possess a relatively high proportion of clay and sand particles (**Appendix 8.1, Appendix D, Appendix F** and **Appendix G**), 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. If additional hardcore material is necessary to import during the construction phase, 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. Guidance which will be applied is as follows:

- 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 includes identification of suitable temporary set down areas which will be located within the Project 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**).

#### 8.5.2.2.3 Mitigation by Remediation

On completion of the construction stage, any areas not required for operation will be reinstated. This will include the Temporary Construction Compound, turning areas and the Borrow Pit location. Granular material will be removed as required and reinstated with peat or other soils in keeping with the adjacent soils. Drainage measures will be reinstated as required in order to minimise future erosion of the soils. The mitigation measures listed above, namely backfilling with peat in layers, are in effect remediation measures, whereby the impact of required excavation works is remediated and limited to the extent of the actual proposed infrastructure. This will be carried out at the designated reinstatement locations, infilling with material in identified soil horizons as mentioned above to revert these areas to baseline levels.

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 Project and improve degraded areas of the Site, thus offsetting the adverse impacts of the Project.

### *8.5.2.3 Storage of Stockpiles*

#### 8.5.2.3.1 Mitigation by Avoidance and Good Practice

Best practice will be applied during construction which will minimise the amount of soil and rock excavation and therefore also reduce storage and stockpile requirements. All works will be managed and carried out in accordance with the Construction and Environmental Management Plan (CEMP), which will be updated by the civil engineering contractor in accordance with the conditions of any grant of permission and agreed prior to any Site works commencing.

No permanent stockpiles will remain on the Site. All excavated materials from the Site or introduced materials for construction will be either used for infilling/ reinstatement purposes 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. No temporary stockpile placed on established hardstands or within the Project footprint in areas of peat (**Appendix 8.1 – App B Peat Database**) will be in excess of 1 m 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.

Mitigation measures to address the entrainment of solids in runoff are detailed in **Chapter 9: Hydrology and Hydrogeology**, and in **Appendix 2.1**, **Management Plan 4 Peat and Spoil Management Plan** which provides for 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 (35,504 $m^3$), however when managed appropriately (ongoing reinstatement) the volume of material to be managed at any particular time will be minimised. Whenever possible, soil and rock will be re-used on the Site immediately, thereby reducing the need for double handling, reducing the requirements of stockpiles. Generally excavated rock will be used immediately for Site Access Track construction. Topsoil and peat will be transported to the designated spoil storage areas. Peat will only be stockpiled temporarily in areas of thin or absent peat (generally towards the eastern end of the Site, **Appendix 8.1 – App A**), and only in areas which have been assessed for stability by a suitably experienced geotechnical engineer.

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 ensures 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 follows: stockpiles will be restricted to less than 1 m in height and will be subject to approval by the Site Manager and Environmental Clerk of Works (EnvCoW). 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 Ground Stability*

#### 8.5.2.4.1 Mitigation by Avoidance and Good Practice

Peat and slope stability investigations at the Site (**Appendix 8.1**) indicate that the Site has a generally low risk probability with respect to peat slippage and slope failure under the footprint of the Project. Nonetheless, the following mitigation measures will also be applied as described in the PSRA (included as **Appendix 8.1**):

- Short term temporary stockpiles will be limited to 1 m height and removed for reuse/remediation purposes or transported to the Borrow Pit as fill. It is proposed 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.

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 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 measures will be implemented for all phases and locations for construction of new infrastructure, for example:

a. All works in close proximity to sensitive receptors, that is; any works with receptor buffer zones, for example, works associated with watercourse crossings. With very little distance between works and receptor, minor or localised stability issues can lead to significant consequences.
   This includes, but us not limited to:
   - Watercourse Crossings WC1, WC2 and WC3, and associated access tracks works within Surface Water buffers.

b. Hardstands and access tacks in close proximity to relatively deep peat and/or steep inclines, that is; works associated with or proximal to geo-hazards.
   This includes, but us not limited to;
   - Areas adjacent to T1, in particular deep peat to the north / northwest, and relatively steep inclines to the south.
   - Areas adjacent to T3, in particular deep peat to the north / northeast, and relatively steep inclines and elevated landslide susceptibility (GSI) to the south / southeast / east.
   - Areas adjacent to T4, in particular relatively steep inclines and elevated landslide susceptibility (GSI) to the south / southeast / east.
   - Areas adjacent to access tracks leading to T1/T2/T3, in particular deep peat to the north, and steep inclines and elevated landslide susceptibility (GSI) to south of T1 to T3 access track.

c. Where the previous two points occur in combination, that is; geohazards which are above or upgradient of 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 **Figure 8.7**, are the most important locations to advance with due care and consideration.

- 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 (**Appendix 9.6 – Tile 11**). 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 >1 m (proposed locations of T1 and T3). 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 and in turn increase pore water pressure which can potentially lead to instability.
- Peat will be carefully managed particularly when in temporary storage. Due to peat's fluid-like properties, all peat excavated will be immediately removed from sloping areas. 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 (**Appendix 9.6 – Tile 12**). 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 **(Appendix 9.6 – Tile 11, Tile 14)**. Temporary measures such as dewatering and pumping through silt bags (**Appendix 9.6 – Tile 15),** will be employed to assist this process. Draining of stockpiled peat, in a controlled manner is proposed (**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. These measures will also be applied to the management of subsoil arisings at the Site.
- Peat is required for reinstatement, therefore acrotelm peat (top living layer, c. 0.5 m) will be stripped off the surface of the bog, segregated, and placed carefully at the margins of the Project along the Site Access Roads and Turbine Hardstand margins that are characterised by near-horizontal slopes (<6°), (**Appendix 9.6 – Tile 23).**
- Relatively high impact construction activities (e.g., excavations, movement of soils / subsoils / rock) will be carried out throughout the year, while taking into account the various restrictions of the Project, (for example, breeding bird seasons). 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 has been developed for the construction phase of the Project (**Appendix 2.1: CEMP, Management Plan 1: Emergency Response Plan**), particularly during the early excavation phase. This, at a minimum, will involve 24-hour advance meteorological forecasting (Met Éireann) 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 >25 mm/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 and receptors (**Appendix H**) where the presence of steep inclines (T2, T3, T4 and T5), deep till deposits and iron pan (T2, T3, T5) give rise to elevated ground stability (T3, T4, T5), 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 (**Appendix 9.6 – Tile 11, Tile 15, Tile 16)** near / towards Geo-Hazard areas where possible. If unavoidable, due to slope direction etc., attenuation and erosion control will be implemented, as discussed under **Chapter 9: Hydrology and Hydrogeology**. Consequences of impacting, diverting and/or concentrating runoff in or towards geo-hazard constraints will potentially impact on stability at the Site.

Vehicular movements will be restricted to the footprint of the Project, 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 hardstand and track 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 hardstands, no vehicles will be permitted outside of the footprint of the Project and will not move onto land that is not proposed for the Project.. Vehicular access to any areas of deep peat (>1 m), i.e., the vicinity of T1, during construction will be restricted to low ground pressure vehicles, with all construction vehicles travelling on existing access tracks whenever possible.

Best practice will be applied during construction which will minimise the risk of ground instability. All works will be managed and carried out in accordance with the Construction Environmental Management Plan (CEMP, **Appendix 2.1**), which will be updated by the civil engineering contractor in accordance with the conditions of any grant of permission and agreed prior to any Site works commencing.

A Geotechnical Clerk of Works will be employed during the construction phase in order to continuously monitor areas of peat. Ongoing physical stability checks and calculations will be undertaken in order to verify that safety standards are being met.

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 Project will in effect reverse any impact by vehicular movement within the footprint of the Project.

#### 8.5.2.4.2 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 Project. This will be achieved by means of appropriate planning and logistical considerations forming part of the CEMP (**Appendix 2.1**), these measures will also be applied 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**).

#### 8.5.2.4.3 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 potential impacts with respect to the immediate area adjacent to the Project 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, **Appendix 9.6 – Tile 22 and Tile 23.** 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 Project, emergency response measures have been prescribed below and as part of the Construction Environment Management Plan, **Appendix 2.1 - Management Plan 1.**

#### 8.5.2.4.4 Emergency Response and Monitoring

Mitigation measures as outlined in the previous sections will reduce the potential for stability issues arising during the decommissioning and construction phase of the Project. 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 under **Section 6.1: Procedures to be followed in the event of an incident** in **Management Plan 1 of the CEMP**:

- 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 implement the following measures 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".[19]
- 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, an equally dynamic yet robust framework to follow in the event of an incident has been established. Establishment of an emergency framework will follow relevant guidance (e.g. SNH (2015) Good Practice during Wind Farm Construction) and standard practices, including for health and safety risk assessment 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 as presented in **Section 8.3** 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.

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

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

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.

#### *8.5.2.5 Vehicular Movements*

Vehicular movements will be restricted to the Project footprint (**Figure 8.7**) and advancing ahead of any constructed hardstand will be minimised in so far as practical. This will include any temporary stockpiling. For example, excavation ahead of established hardstands will be in line with expected phases of Turbine Hardstand and Site Access Track 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 approach to limiting vehicular movements and temporary handling of arisings to the Project footprint is very important in the context and scope of peat and slope stability risk assessment and its conclusions (**Appendix 8.1**) and limiting other potential impacts including soil compaction and degradation.

The only exception to limiting vehicular movements to the footprint of the Project will be for forestry clear felling (Tree Felling areas presented in **Figure 8.7**). Clear felling of forestry is in line with baseline conditions / Do Nothing impact, will be carried out in line with forestry operations best practice guidance, and in line with relevant mitigation measures set out in this report in terms of monitoring ground stability locally and managing potential sources of contamination. No intrusive or excavation works are anticipated as part of tree felling activities. The management vehicles used for tree felling will align with measures set out in this report, for example; spill kits to hand, etc. During construction down time / overnight, vehicles will be stored in suitable locations on the Project footprint and not left un-manned on vegetated / tree felling / soils areas, or within sensitive areas / receptor buffers.

Where vehicular movements are necessary outside of the Project footprint, ground conditions will be maintained and reinstated. 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.

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.

Implementation of proposed mitigation measures described will minimise the adverse impacts posed by vehicular movements, and any localised unforeseen impacts will trigger escalation of response ensuring locations are restored and any potential pathways to receptors are isolated.

### *8.5.2.6 Soil Contamination*

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

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. The CEMP will be developed to include the scheduled checks of assets (plant, vehicles, fuel bowsers) on a regular 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 Project.

#### 8.5.2.6.1 Mitigation by Avoidance and Good Practice

##### 8.5.2.6.1.1 Release of Hydrocarbons

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 was 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.** To control and contain any potential hydrocarbon or other harmful substance spillages by vehicles during construction. Plant equipment will be refuelled off the development Site, thus mitigating this potential impact by avoidance.

Where fuelling offsite is impractical (e.g., bulldozers, cranes, etc.) and fuelling must occur on Site, all oil and chemical storage facilities will be bunded to 110% volume capacity of fuels stored at the Site, **Appendix 9.6 – Tile 19**. A "fuel station" will be designated for the purpose of safe fuel storage and fuel transfer to vehicles, located at the Temporary Contractor's Compound. Furthermore, an Emergency Response Plan will be in place as part of the Construction and Environment Management Plan (**Appendix 2.1**) before consented works are carried out.

As discussed, construction activities will be restricted to the footprint of the Project, therefore the potential for contaminants reaching soils is likely limited to the footprint of the Project 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).

A fuel management plan will be prepared (and included in the CEMP) which will incorporate the following elements:

- Mobile bowsers, tanks and drums will be stored in secure, impermeable storage area, away from drains and open water;
- Fuel containers will be stored within a secondary containment system e.g., bund for static tanks or a drip tray for mobile stores
- Ancillary equipment such as hoses, pipes will be contained within the bund
- Taps, nozzles or valves will be fitted with a lock system
- Fuel and oil stores including tanks and drums will be regularly inspected for leaks and signs of damage
- Only designated trained operators will be authorised to refuel plant on Site.

In the event of an accidental spill during the construction, operational or decommissioning phase of the Project, contamination occurrences will be addressed immediately, this includes the cessation of works in the area of the spillage until the issue is resolved. In this regard, appropriate spill kits, **Appendix 9.6 – Tile 20**, will be provided across the Site to deal with the event of a spillage and made available at all times. Spill kits will contain a minimum of; oil absorbent granules, oil absorbent pads, oil absorbent booms, and heavy-duty refuse bags (for collection and appropriate disposal of contaminated matter). Staff will be trained in their use and details of personnel and location and type of spill kits will be listed in the CEMP (**Appendix 2.1**), which will be updated by the selected site Contractor. No materials contaminated or otherwise will be left on the Site. Suitable receptacles for hydrocarbon contaminated materials will also be at hand. Upon usage, spill kits will be promptly replaced.

In the event of a significant or catastrophic hydrocarbon spillage, emergency responses will be escalated accordingly. Escalation will 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. 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.

The mitigated impacts associated with hydrocarbons is considered to be **neutral to slight and temporary.**

#### 8.5.2.6.1.2 Release of Horizontal Drilling Fluid and Material

In order to mitigate the potential impact posed by the use of drilling fluid material and the associated effects on the receiving environment, the following precautions and mitigation measures are recommended:

- Spoil from drill arisings will be managed akin to mitigation measures outlined in **EIAR Chapter 9: Hydrology and Hydrogeology** for the release of suspended solids, in that arising will require temporary stockpiling which the potential to be entrained by surface water runoff. This includes but is not limited to: stockpiling out of designated surface water buffer zones and the utilisation of silt fencing around stockpiles to contain sediment laden runoff.
- In the case of a major spill or a breakout and drilling fluid return, the leak will be stopped if safe to do so, contained and prevented from entering drains or water courses. Any recoverable product will 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.
- In terms of drilling fluid disposal, 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 at sufficient rates. To address this, flocculant will be used to promote the settlement of finer solids prior to discharging to surface water networks, **Appendix 9.6 – Tile 14**. 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.[20] Therefore, if flocculants are deployed the material used must be made from anionic polymers. Flocculants are discussed in greater detail in **EIAR Chapter 9: Hydrology and Hydrogeology.**

The mitigated impacts associated with HDD arisings is considered to be **not significant.**

#### 8.5.2.6.1.3 Release of Wastewater and Sanitation Contaminants

A temporary compound area will be constructed on-site to contain temporary facilities for the construction phase including 'port-a-cabin' structures. The temporary compound will be constructed on a base of geo-textile matting laid at ground level. This will be stabilized with the laying of hardcore material on top. During the construction phase, foul effluent will be periodically removed for offsite disposal.

Wastewater/sewerage from the staff welfare facilities located in the Temporary Construction Compound will be collected and held in a sealed storage holding tank, fitted with a high-level alarm. The high-level alarm is a device installed in the storage tank that is capable of sounding an alarm during a filling operation when the liquid level nears the top of the tank. Chemicals are likely to be used to reduce odours.

All wastewaters will be emptied periodically, tankered off-site by a licensed waste collector to the local wastewater sanitation plant for treatment. There will be no onsite treatment of wastewater. A wastewater or sewerage leakage is not anticipated in a properly managed Site.

The mitigated impacts associated with wastewater and sewerage is considered to be **temporary and neutral to slight.**

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

#### 8.5.2.6.1.4 Release of Construction and Cementitious Materials

In order to mitigate the potential impact posed by the use of concrete and the associated effects on the receiving environment, the following precautions and mitigation measures will be implemented, as set out in the CEMP **(Appendix 2.1):**

- Precast concrete will be used wherever possible i.e., formed offsite. Elements of the Project where the use of precast concrete is not possible includes turbine foundations. Where the use of precast concrete is not possible the following mitigation measures will apply:
- Lean mix concrete, often used to provide protection to main foundations of infrastructure from soil biome, will be minimized, limited to the requirement of turbine foundations if necessary. Lean mix concrete can alter the pH of water if introduced, which would then require the treatment of acid before being discharged to the surrounding environment. The risk of runoff will be minimal, as concrete will be contained in an enclosed, excavated area
- The acquisition, transport and use of any cement or concrete on Site will be planned fully in advance of commencing works by the Contractor's Environmental Manager and supervised at all times by the Developer appointed Environmental Clerk of Works (EnvCoW).
- There will be no excess cementitious material on the vehicle which could be deposited on trackways or anywhere else on Site. To this end, delivery trucks, tools and equipment will be cleaned at designated washout areas located conveniently and within a controlled area of the Site. Vehicles will undergo a visual inspection prior to being permitted to drive onto the proposed Site or progress beyond the contractor's yard.

In addition, the following drainage measures will apply;

- Any shuttering installed to contain the concrete during pouring will be installed to a high standard with minimal potential for leaks. Additional measures will be taken to ensure this, for example the use of plastic sheeting or other sealing products at joints.
- Concrete will be poured during periods of minimal precipitation. This will reduce the potential for surface water run off being significantly affected by freshly poured concrete. This will require limiting these works to dry meteorological conditions i.e., avoid foreseen sustained rainfall (any foreseen rainfall event longer than 4-hour duration) and/or any foreseen intense rainfall event (>3 mm/hour). This also will avoid such conditions while concrete is curing, in so far as practical.
- Ground crew will have a spill kit readily available, and any spillages or deposits will be cleaned/removed as soon as possible and disposed of in accordance with the Waste Management Plan (see **Appendix 2.1; CEMP, Management Plan 5: Waste Management Plan**).

- Pouring of concrete into standing water within excavations will not be undertaken. Excavations will be prepared before pouring of concrete by pumping standing water out of excavations to the buffered surface water discharge systems in place.
- No surplus concrete will be stored or deposited anywhere on Site. Such material will be returned to the source location or disposed of off-site appropriately.

Elements of the Project where precast concrete will be used will be identified in the CEMP. Elements of the Project 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.

Supplementary mitigation measures outlined in **Chapter 9: Hydrology and Hydrogeology** to surface water receptors will also apply. The mitigated impacts associated with construction waste is considered to be **neutral to slight.**

#### *8.5.2.7 General Waste*

All construction and operation waste materials will be correctly sorted, recycled or disposed of in accordance with good site practice described in Management Plan 5 of the CEMP, a policy of Reduce, Reuse and Recycle will apply. The mitigated impacts associated with general waste is considered to be **temporary** and **neutral to slight.**

#### *8.5.2.8 Material and Waste Management*

A site-specific Peat and Spoil Management Plan and a Waste Management Plan have 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 will not exceed original ground level. In essence, no permanent stockpiles will be established as a product of the construction phase of the Project, 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 **EIAR Appendix 2.1**, Management Plan 5: Waste Management. In the event of waste arising at the Site, management of waste arising from the construction phase of the Project 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

All materials used on Site and wastes generated on Site will be reduced by good Site practice. 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 Project, 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 Appendix 2.1** and **Chapter 13: Material Assets**. A policy of reduce, re-use and recycle will apply. All waste will be segregated and re-used where possible or removed from Site for recycling. Any waste which is not recyclable or compostable will be properly disposed of to landfill.

#### *8.5.2.9 Mitigated Sequence of Events During Wind Farm Construction on the Receiving Environment*

The following sections outlines and summarises the general stages or elements of construction related to the Project. In contrast to **Section 8.4.3.1 Typical Sequence of Events in Wind Farm Construction on the Receiving Environment,** the following sequence includes a high level description of mitigation which is relevant to the respective steps. Specific details and important design considerations for mitigation measures prescribed in response to each activity type are discussed in the previous sections. Cross referencing to **EIAR Chapter 9: Hydrology and Hydrogeology** is included due to the consistent relationship between disciplines, namely; hydrology, hydrogeology, geology.

#### 8.5.2.9.1 Activities – With Mitigation

1. General Site Preparation:

- Install Surface Water Monitoring Equipment: It's important to install surface water monitoring equipment in downstream rivers to monitor the impact of construction activities on water quality. This equipment can include water quality sensors, flow meters, and sediment samplers, among others. The monitoring equipment will be installed prior to works commencing construction activities to establish baseline data and will continue to be monitored throughout the construction process to ensure compliance with environmental quality standards.
- Install Silt Screens, Interceptor Drains, and SuDS: To manage runoff and sediment control during the initial phases of construction, it's important to install silt screens, interceptor drains, and SuDS. Silt screens will be installed along the perimeter of the Site to capture sediment and prevent it from entering watercourses. Interceptor drains will be installed to divert runoff away from construction areas and towards designated settling ponds or treatment systems. SuDS, such as permeable pavement or infiltration trenches, will also be installed to manage runoff and reduce the impact of construction on the Site's hydrology. This work involves excavation activities and spoil management.
- Prepare Temporary Stockpile Areas: It's important to prepare designated temporary stockpile areas for the different types of waste generated during the construction process. This includes separate areas for vegetation, topsoil, subsoil, and other types of waste. These areas will be prepared in a location that minimizes the potential for runoff and erosion.
- Clear Vegetation and Soils: As part of site preparation, it's important to clear the vegetation and topsoil to prepare the area for construction. This will include cutting down trees and removing all vegetation from the Site, including grass, shrubs, and bushes. The vegetation and topsoil are temporarily stockpiled in designated areas in addition, the subsoil is also removed to the required depth to prepare the area for construction, and it's also stockpiled in a designated area for later use in the restoration of the Site.
- Excavate and grade the area for the construction of access tracks, hardstand areas, foundations, and other significant infrastructure units. This work involves excavation activities and spoil management.

2. Access Track and Hardstand Areas:

- Install silt screens, interceptor drains, and temporary SuDS:
    - Install silt screens along the perimeter of the Site to capture sediment and prevent it from entering watercourses.
    - Install interceptor drains to divert runoff away from construction areas and towards designated settling ponds or treatment systems.
    - Install SuDS, such as permeable pavement or infiltration trenches, to manage runoff and reduce the impact of construction on the Site's hydrology.
    - Ensure that all drainage structures and SuDS are regularly inspected and maintained to prevent blockages and ensure proper functioning.
    - Monitor water quality downstream of the construction Site to assess the effectiveness of these measures in managing runoff and sediment control.
- Clear vegetation and soil layers:
    - Cut down trees and remove all vegetation from the Site where relevant, including grass, shrubs, and bushes.
    - Stockpile vegetation in a designated area for later removal or use in the restoration of the Site.
    - Remove the acrotelm peat and/or topsoil to the required depth to prepare the area for construction.
    - Stockpile the acrotelm peat and/or topsoil in a designated area for later use in the restoration of the Site.
    - Remove the catotelm peat and/or subsoil to the required depth to prepare the area for construction.
    - Stockpile the catotelm peat and/or subsoil in a designated area for later use in the restoration of the Site.
    - Use silt screens and other temporary measures to manage runoff and prevent sediment from entering watercourses or drains.
- Install drainage structures and erosion control measures, such as culverts and Permanent SuDS.
- Construct the road base and hardstand using suitable materials, such as crushed rock or concrete.
- Construct hardstand areas for the installation and maintenance of wind turbines.
- Use designated temporary stockpile areas and segregation of materials for different types of material, including materials arising at the Site, and being imported to the Site. Types of material to be segregated and managed separately;
    1. Topsoil
    2. Acrotelm Peat

3. Catotelm Peat
4. Subsoil – this can be subdivided between material suitable or unsuitable for engineering fill etc.
5. Weathered or crushed rock
6. Specific waste streams including contaminated soil is it arises.

3. Drainage & Sustainable Drainage Systems (SuDS)

- Sustainable Drainage Systems (SuDS): SuDS are a set of techniques that are designed to manage surface water runoff in a more sustainable way than traditional drainage systems. SuDS mimic natural drainage processes by promoting infiltration, evapotranspiration, and the use of storage and delayed release systems. They can include a range of features such as permeable paving, green roofs, and rain gardens.
- Designing SuDS: The design of SuDS will be site-specific and tailored to local conditions. It will consider the Site's topography, soil type, rainfall intensity, and available space. The design will also incorporate a range of techniques to manage runoff, such as infiltration, storage, and conveyance. The aim of SuDS is to reduce the volume and rate of runoff, improve water quality, and provide amenity and biodiversity benefits.
- Benefits of SuDS: The benefits of SuDS are numerous, including reducing the risk of flooding, improving water quality, enhancing biodiversity, and creating green spaces. SuDS can also provide additional benefits, such as reducing urban heat island effects, improving air quality, and enhancing the visual amenity of an area.
- SuDS maintenance: SuDS require regular maintenance to ensure they continue to function effectively. This includes regular inspections, cleaning of drainage systems, and the removal of debris and sediment. Maintenance is essential to ensure that the SuDS system continues to provide the intended benefits and meets regulatory requirements. Maintenance will be carried out by a trained and experienced professional, and a maintenance plan will be developed for each individual SuDS system.
- Construction of Drainage Channel: The drainage channel will be constructed with a lining of coarse aggregate to reduce erosion and promote infiltration. The channel will be graded appropriately to ensure proper flow, and regular outfalls will be included to promote diffuse discharge to vegetated (low risk) areas where possible.
- Installation of Check Dams: In line check dams will be installed in a continuous manner along the drainage network to slow down the flow of water, reduce erosion, and promote sediment deposition. The design, placement, and construction of check dams

will be carefully considered to ensure that they are effective in reducing the velocity of runoff while not impeding the flow of water.

- Purpose of SuDS: The use of SuDS, including coarse drainage, check dams, and stilling ponds, serves several purposes. They attenuate runoff by slowing down the flow of water, settling out gross solids, promoting recharge by allowing water to infiltrate into the soil, reducing the hydrological response to rainfall at the Site, and supporting potential biodiversity gains by creating suitable habitat for certain plant and animal species.
- Installation of outfalls: Once the drainage channel is constructed, outfalls will be installed at regular intervals to manage runoff and prevent erosion. Stilling ponds will be installed at the base of the outfall to slow down the flow of water and allow sediment to settle out. Buffered outfalls will be used where the drainage channel discharges into sensitive receiving waters, and outfalls will be directed towards vegetated areas where possible.
- Maintenance: A regular maintenance program will be established for the drainage system to ensure that it continues to function effectively. This will include regular inspections of the drainage channel and outfalls to identify any erosion or damage, as well as routine cleaning and removal of accumulated sediment.

4. Watercourse crossings and culverts:

- Culverts:
  - In line with, inter alia, SEPA (2010) Engineering in the Water Environment Good Practice Guide for River Crossings, design and plan the culvert to meet the required hydraulic capacity and align with the watercourse's natural flow pattern.
  - Install silt screens and sediment traps upgradient of the construction area to intercept, manage and divert runoff, reduce entrainment of solids and capture sediment and prevent it from entering the watercourse.
  - Divert the watercourse flow, if necessary, to facilitate the construction of the culvert. This will involve temporarily diverting the watercourse or over-pumping the water to a temporary diversion channel.
  - Excavate the area for the culvert installation, taking care to prevent sediment from entering the watercourse.
  - Use Active Construction Water Management techniques to remove silt/solid laden waters and sludges/slurries. This will include excavation dewatering and pumping of construction waters to a treatment tank / settlement tank, equipped with monitoring and treatment equipment as required.

  - Construct the culvert using suitable materials, such as precast concrete segments, to the required size and shape.
  - Backfill the area around the culvert with suitable materials to ensure the culvert is properly supported and to prevent settlement.
  - Install headwalls at the inlet and outlet of the culvert to protect the culvert and prevent erosion.
  - Restore the natural watercourse flow and conduct any necessary erosion control measures, such as seeding or installing erosion control blankets.
  - Maintaining or improving ecological value at each culvert crossing will be achieved.
- Clear Span Bridges:
  - In line with, inter alia, OPW (2019) (05-3) A Guide to Applying for Consent under Section 50 of the Arterial Drainage Act 1945, design and plan the clear span bridge to meet the required hydraulic capacity and align with the watercourse's natural flow pattern. Abutments will be positioned as far back as reasonably practical; it is proposed to maximise the width in nearly all circumstances. The indicative max width of a clear span bridge is 10-12 m.
  - Prepare the area for the bridge construction, taking care to prevent sediment from entering the watercourse.
  - Install silt screens and sediment traps upstream of the construction area to capture sediment and prevent it from entering the watercourse.
  - Diversion of the watercourse flow will not be required as part of the construction of single span structures. Single span structures are proposed mainly due to the fact there are no in stream structures or works required.
  - Construct the bridge abutments and piers using suitable materials, such as concrete or steel, to the required size and shape.
  - Install the bridge beams or arches using suitable materials, such as steel or composite materials, to span the watercourse.
  - Backfill the areas around the abutments and piers with suitable materials to ensure they are properly supported and to prevent settlement.
  - Install any necessary guardrails or barriers to protect the bridge users.
  - Restore the area and conduct any necessary erosion control measures, such as seeding or installing erosion control blankets.

5. Foundations:

- Excavate the area to the required depth and diameter for the wind turbine foundation. Foundation dimensions: 2.8 m to 3.2 m depth, 22 m to 22.5 m diameter.

- Excavate and Backfill: To construct the wind turbine foundation, the area will be excavated to the required depth ranging from 2.8 m to 3.2 m and diameter ranging from 22 m to 22.5 m. The excavation volume for Turbine Foundations and Met Mast Foundations will range from 1,938 $m^3$ to 3,601 $m^3$ (see **Appendix 2.1: CEMP, Management Plan 4: Peat and Spoil Management Plan**). Foundation locations will be excavated to a greater depth, such as 4.0 m depth, and backfilled to around 2.5 m below ground level with crushed rock.
- Form and Pour Foundation: Shuttering and membranes are used to form the foundation pour structure, and foundation reinforcement steel rebar is installed and formed. Concrete is then poured into the foundation structure.

6. Other Significant Infrastructure Units:

- Construct Infrastructure Units: Other significant infrastructure units, such as substation buildings, electrical cabling, and meteorological masts, will be constructed using suitable materials such as concrete or steel.
- Install Drainage Structures and Erosion Control Measures: As with access track and hardstand areas, drainage structures and erosion control measures such as culverts and erosion control blankets will be installed for other significant infrastructure units.

7. Site Restoration:

- Backfilling: Excavation areas, such as those where wind turbine foundations were installed, will be backfilled with suitable soil or subsoil materials to restore the land's natural contours and soil properties. The backfilling process will be done in such a way that it mirrors the baseline conditions of the Site, including the depths of the subsoil and topsoil layers. This will help to restore the land's original drainage patterns and prevent erosion.
- Soil and Vegetation: Topsoil / Catotelm Peat that was removed during the Site preparation phase will be redistributed and seeded with appropriate vegetation to help stabilize the soil and prevent erosion. The soil (topsoil) will be tested for its nutrient content, and appropriate soil amendments will be used as needed to encourage healthy vegetation growth.
- Erosion Control: Measures such as seeding, mulching, or installing erosion control blankets will be necessary in areas where vegetation is slow to establish, or in areas with steep slopes or exposed soil. These measures will be implemented as required and will help to stabilize the soil and prevent erosion.
- Landscaping: Landscaping will be necessary to restore the Site to its original state. This will be limited to the development footprint where excavations and associated vehicular

movements are limited to. This will include as necessary planting suitable vegetation e.g. trees/hedge/shrubs in agricultural settings, sphagnum in peat settings..

- Monitoring: Post-construction monitoring of soil and water quality will be conducted to ensure that the Site is returning to its pre-construction state. This will involve testing for pollutants or other contaminants that could have been introduced during the construction phase, and taking corrective measures as needed.
- Waste Management: Waste, including waste soil/subsoil, will be minimised. This will be achieved by means of a robust and efficient **Peat and Spoil Management Plan** and **Waste Management Plan** (**Appendix 2.1 CEMP**; Management Plan 4 and 5, respectively). Any remaining construction materials or waste will be properly disposed of or recycled, in accordance with local regulations. This will include materials such as soil, rock, concrete, metal, or plastic, as well as hazardous waste such as batteries or oils.

Overall, the restoration phase is an important part of the wind farm construction process, as it ensures that the land is returned to its original state and can continue to support the ecosystem and local communities. A positive commitment to achieve neutral impacts at a minimum and to promote beneficial impacts where possible will inform the setting of objectives. It is important to carefully plan and execute this phase to ensure that the restoration is successful and meets the objectives which will incorporate all relevant environmental objectives, standards and targets.

#### *8.5.2.10 Construction Phase Residual Effects*

Mitigation measures outlined in this report lay down the framework to avoid and minimise all potential impacts of the Project on Geological receptors. 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 mtigated potential impacts lay down the achievable benchmarks provided measures are considered and implemented adequately, including adequate monitoring, and escalation of emergency responses if required.

The residual impacts after implementation of all mitigation measures for the construction phase of the development are summarised and presented in **Table 8.11.**

#### *8.5.2.11 Operational Phase Residual Effects*

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

Maintenance and monitoring during the operational phase of the Project 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. All wastes from the control building and ancillary facilities will be removed by the appropriate contractor. The operational team will carry out maintenance works (to Site Access Tracks, Onsite Substation and turbines) and will put in place control measures to mitigate the risk of hydrocarbon or oil spills during the operational phase of the windfarm. Any vehicles utilised during the operational phase will be maintained on a weekly basis and checked daily to ensure any damage or leakages are corrected.

Regular monitoring, similar to the construction phase but on a less frequent basis will be required i.e. monthly. The Project 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.

#### *8.5.2.12 Operational Phase Residual Effects*

The potential effects on the soil and geological environment during the operational phase of the work will be mitigated through good Site practice; vehicular movements, hydrocarbon controls, sustainable use of natural resources, human health etc. as discussed previously. Overall, the residual effects from these aspects will have a **slight to moderate, permanent, adverse** effect on the Site. The residual effect of land take for the operational windfarm has a **slight to moderate, long-term to permanent** but **reversible** after decommissioning and restoration effect of the Development.

### 8.5.3 Development Decommissioning and Restoration Phases

#### *8.5.3.1 Decommissioning of Infrastructure*

Following the permitted lifespan of the wind farm, decommissioning of the infrastructure will occur. Decommissioning of the proposed windfarm will include:

- Removal of five wind turbines and concrete plinths.
- Removal of permanent meteorological mast.
- Removal of all associated underground electrical and communications cabling connecting the wind turbines to the wind farm substation. Ducting is to remain in-situ.

Cranes of similar size to those used for construction will disassemble each turbine using the same crane hardstands. Turbines will be cut on Site so as to fit on articulated trucks, therefore allowing the use of the civil construction delivery route for removal. All physical infrastructure; towers, blades and all above ground components will be removed from Site and reused, recycled, or disposed of in a suitably licenced facility as appropriate.

Residual impacts after the decommissioning phase are complete include all impacts classified as being long-term to permanent effects of the Project, 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, adverse, moderate significance, direct permanent** change to the materials composition at the Site.

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 be required to evaluate any such activity before it is permitted. 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. 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 is noted that restoration activities do not currently conform to baseline conditions.

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. 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 Project, potential issues arising giving cause to residual effects 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 Project, 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.

### 8.5.4 Cumulative Effects

Considering the discipline under investigation, soils and geology, and the fact that potential effects of the Project on same are generally localised, the cumulative effects of the Project 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, outlined in **Appendix 2.5**, 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 effects on land use are likely to be imperceptible to slight. 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 assesses all elements of the Project in terms of Land, Soils, and Geology. The potential impacts that could arise from the Project during the construction, operational and decommissioning phases relate to the potential for increased stability issues and the erosion of soils and entrainment of solids in runoff associated with Site preparation activities and excavations for the infrastructure elements including the turbine foundations and cable trenches.

The unavoidable residual impacts on the soils and geology environment as a function of the Project 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.

Other potential impacts are considered to range in significance from Slight to Moderate, **Table 8.11**, while others range from Significant to Profound (e.g., Landslide – *worst case*). Providing the prescribed mitigation measures outlined in this report are fully implemented and best practice is followed on Site, the risk of such potential impacts can be significantly reduced or in some cases are considered avoidable resulting in neutral impacts. Furthermore, some impacts have some benefit to the receiving environment, including the incremental clear fell of forestry.

No new impacts are anticipated during the operational phase of the Project. Similar impacts are identified when comparing the construction and operational phases of the Project (i.e., hydrocarbon spill, excavations, etc.), 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 Project however the phase will be considered similar in nature to the construction phase in terms of impacts and application of mitigation measures.

A summary of Potential Effects on the receiving environment from the Project is presented in the following table. The table presents both un-mitigated or pre-mitigation effects, and anticipated effects with the adequate application of the prescribed mitigation measures.

**Table 8.11: Summary of Potential Effects on receiving environment from the Project in the absence of and with mitigation measures.**

| | | Qualifying Criteria Pre-Mitigation | | | | | | | | | Qualifying Criteria with Mitigation | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Effect / Impact Description** | **Phase** | **Type** | **Quality** | **Scale** | **Significance** | **Extent** | **Context** | **Probability** | **Duration / Frequency** | **Mitigation Applied** | **Quality** | **Significance** |
| **Land Take Grid Connection Route** | Construction | Direct * | Adverse | Small | Slight | Localised | Conforms to Baseline e.g., public roads. | Unavoidable | Permanent but Reversible | Yes | Adverse | Slight |
| **Land Take Turbine Delivery Route** | Construction | Direct * | Adverse | Small | Slight | Localised | Conforms to Baseline e.g., public roads. | Unavoidable | Permanent but Reversible | Yes | Adverse | Slight |
| **Clear Felling of Afforested Areas** | Construction | Direct * | Adverse | Small to Moderate | Moderate | Development Footprint and turbine buffer felling zones. | Conforms to baseline e.g., forestry tracks or operations) | Unavoidable | Permanent but Reversible | Yes | Adverse to Beneficia l | Slight Adverse to Small Beneficial |

| | | Qualifying Criteria Pre-Mitigation | | | | | | | | | Qualifying Criteria with Mitigation | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Effect / Impact Description** | **Phase** | **Type** | **Quality** | **Scale** | **Significance** | **Extent** | **Context** | **Probability** | **Duration / Frequency** | **Mitigation Applied** | **Quality** | **Significance** |
| **Subsoil and Bedrock Removal – General Excavations** | Construction | Direct * | Adverse | Large | Slight to Moderate | Development Footprint | Conforms to baseline e.g., Agri/forestry tracks or operations) | Unavoidable | Permanent but Reversible | Yes | Adverse | Slight to Moderate |
| **Subsoil and Bedrock Removal – Site Access Tracks** | Construction | Direct * | Adverse | Moderate to Large | Slight to Moderate | Development Footprint | Conforms to baseline e.g., Agri/forestry tracks or operations) | Unavoidable | Permanent but Reversible | Yes | Adverse | Slight to Moderate |
| **Subsoil and Bedrock Removal – Hardstand and Foundation Areas** | Construction | Direct * | Adverse | Moderate to Large | Slight to Moderate | Development Footprint | Conforms to baseline e.g., Agri/forestry tracks or operations) | Unavoidable | Permanent but Reversible | Yes | Adverse | Slight to Moderate |

| | | Qualifying Criteria Pre-Mitigation | | | | | | | | | Qualifying Criteria with Mitigation | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Effect / Impact Description** | **Phase** | **Type** | **Quality** | **Scale** | **Significance** | **Extent** | **Context** | **Probability** | **Duration / Frequency** | **Mitigation Applied** | **Quality** | **Significance** |
| **Subsoil and Bedrock Removal – Borrow Pit** | Construction | Direct * | Adverse | Moderate to Large | Slight to Moderate | Development Footprint | Conforms to baseline e.g., Agri/forestry tracks or operations) | Unavoidable | Permanent but Reversible ** | Yes | Adverse | Slight to Moderate |
| **Subsoil and Bedrock Removal – Site Cable Trenches** | Construction | Direct * | Adverse | Small to Moderate | Slight | Development Footprint | Conforms to Baseline e.g., public roads and services. | Unavoidable | Permanent / Reversible | Yes | Adverse | Neutral |
| **Subsoil and Bedrock Removal – Turbine Delivery Route** | Construction | Direct * | Adverse | Small | Slight | Localised | Conforms to Baseline e.g., public roads and services. | Unavoidable | Permanent / Reversible | Yes | Adverse | Neutral |

| | | Qualifying Criteria Pre-Mitigation | | | | | | | | | Qualifying Criteria with Mitigation | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Effect / Impact Description** | **Phase** | **Type** | **Quality** | **Scale** | **Significance** | **Extent** | **Context** | **Probability** | **Duration / Frequency** | **Mitigation Applied** | **Quality** | **Significance** |
| **Subsoil and Bedrock Removal – Grid Connection Route** | Construction | Direct * | Adverse | Moderate | Slight | Localised | Conforms to Baseline e.g., public roads and services. | Unavoidable | Permanent / Reversible | Yes | Adverse | Neutral |
| **Spoil Management** | Construction | Direct * | Adverse | Moderate to Large | Slight to Moderate | Development Footprint; Localised | Conforms to Baseline e.g., public roads and services. | Likely | Permanent / Reversible | Yes | Adverse | Neutral / Beneficial |
| **Geological Stability** | Construction | Direct * | Adverse | Small to Large | Slight | Localised | Contrast to Baseline | Unlikely | Permanent | Yes | Adverse | Neutral |

| | | Qualifying Criteria Pre-Mitigation | | | | | | | | | | Qualifying Criteria with Mitigation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Effect / Impact Description** | **Phase** | **Type** | **Quality** | **Scale** | **Significance** | **Extent** | **Context** | **Probability** | **Duration / Frequency** | **Mitigation Applied** | **Quality** | **Significance** |
| **Vehicular Movements - Compaction, Erosion and Degradation** | Construction | Direct * | Adverse | Moderate to Large | Slight to Moderate | Development Footprint | Conforms to Baseline (forestry) | Likely | Permanent | Yes | Adverse | Neutral |
| **Localised Stability Issue (Peat/soil stability issues arising from e.g., vehicular movement or excavations)** | Construction | Direct * | Adverse | Small to Moderate | Slight (to Profound) | Localised (Potentially Regional) | Contrast to Baseline | Likely | Temporary / Reversible | Yes | Adverse | Slight |
| **Landslide – worst case (Stability issues and slope failure arising from e.g., vehicular movement and excavations).** | Construction | Direct * | Adverse | Small to Moderate | Significant (to Profound) | Localised (Potentially Regional) | Contrast to Baseline | Unlikely | Permanent | Yes | Adverse | Neutral |

| | | Qualifying Criteria Pre-Mitigation | | | | | | | | | Qualifying Criteria with Mitigation | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Effect / Impact Description** | **Phase** | **Type** | **Quality** | **Scale** | **Significance** | **Extent** | **Context** | **Probability** | **Duration / Frequency** | **Mitigation Applied** | **Quality** | **Significance** |
| **Soil Contamination - Hydrocarbon** | Construction | Direct * | Adverse | Small | Significant | Localised* | Contrast to Baseline | Likely | Long term / Permanent | Yes | Adverse | Neutral |
| **Soil Contamination - Horizontal Direction Drilling Material** | Construction | Direct * | Adverse | Small | Slight to Moderate | Localised* | Contrast to Baseline | Likely | Short term / Reversible | Yes | Adverse | Slight |
| **Soil Contamination - Wastewater Sanitation – Waste** | Construction | Direct * | Adverse | Small | Moderate to Significant | Localised* | Contrast to Baseline | Likely | Long term / Permanent | Yes | Adverse | Neutral |

| | | Qualifying Criteria Pre-Mitigation | | | | | | | | | Qualifying Criteria with Mitigation | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Effect / Impact Description** | **Phase** | **Type** | **Quality** | **Scale** | **Significance** | **Extent** | **Context** | **Probability** | **Duration / Frequency** | **Mitigation Applied** | **Quality** | **Significance** |
| **Soil Contamination - Wastewater Sanitation – Chemicals** | Construction | Direct * | Adverse | Small | Moderate to Significant | Localised* | Contrast to Baseline | Likely | Long term / Permanent | Yes | Adverse | Neutral |
| **Soil Contamination - Construction of Cementitious Material** | Construction | Direct * | Adverse | Small | Slight to Significant | Localised* | Contrast to Baseline | Likely | Long term / Permanent | Yes | Adverse | Slight |
| **Soil Contamination - General Waste** | Construction | Direct * | Adverse | Small | Slight | Localised* | Contrast to Baseline | Likely | Long term / Permanent | Yes | Adverse | Neutral |

| | | Qualifying Criteria Pre-Mitigation | | | | | | | | | Qualifying Criteria with Mitigation | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Effect / Impact Description** | **Phase** | **Type** | **Quality** | **Scale** | **Significance** | **Extent** | **Context** | **Probability** | **Duration / Frequency** | **Mitigation Applied** | **Quality** | **Significance** |
| **Land Take Wind Farm** | Operational | Direct * | Adverse | Small to Moderate | Slight to Moderate | Development Footprint | Conforms to baseline e.g., Agri/forestry tracks or operations) | Unavoidable | Long term/ Permanent / Reversible after Decommissioning / Restoration | Yes | Adverse | Slight to Moderate |

**Note**:

* Includes Indirect / Secondary impacts to receptors i.e., Hydrology/Hydrogeology. For example: Contamination of soils / peat by hydrocarbons is considered a localised impact, however if hydrocarbon contamination is intercepted by surface water features or groundwater bodies the impact is potentially regional depending in the environmental circumstances (**Chapter 9: Hydrology and Hydrogeology**)

** Not reversible in terms of geology e.g., replacing competent bedrock, but impacts to ground levels will be reversible through reinstatement with fill.

## 8.7 REFERENCES

British Standards Institution (BSI) (1999) Code of Practice for Site Investigations - BS 5930

Department of the Environment, Heritage and Local Government (DEHLG) (2006) *Wind Energy Development Guidelines* (2006)

Environmental Protection Agency (EPA) (2015) *Advice Notes for Preparing Environmental Impact Statements DRAFT September 2015*. Environmental Protection Agency, Ireland

Environmental Protection Agency (EPA) (2022) *Guidelines on the information to be contained in Environmental Impact Assessment Reports*

Environmental Protection Agency (EPA) (ND) *EPA Map Viewer* [Online] - Available at: https://gis.epa.ie/EPAMaps/ [Accessed 14/04/21]

Forestry Civil Engineering Scottish Natural Heritage (FCESNH) (2010) *FLOATING ROADS ON PEAT*

Geological Survey of Ireland (GSI) (ND) *Geological Survey Ireland Spatial Resources* [Online] - Available at: http://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228 [Accessed 21/03/21]

Geological Survey of Ireland (GSI) (ND) *The role of geoheritage: Themes* [Online] – Available at: https://www.gsi.ie/en-ie/programmes-and-projects/geoheritage/activities/background-information/Pages/Themes.aspx# [Accessed 22/03/21]

Institute of Geologists of Ireland (IGI) (2013) *Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements*

Lindsay, R; Bragg, O. (2005) *WIND FARMS AND BLANKET PEAT The Bog Slide of 16th October 2003 at Derrybrien, Co. Galway, Ireland*. University of East London and The Derrybrien Development Cooperative Ltd [Online] Available at: https://www.researchgate.net/publication/258332297_Wind_Farms_and_Blanket_Peat_-_The_Bog_Slide_of_16th_October_2003_at_Derrybrien_CoGalway_Ireland [Accessed 09/03/21]

National Parks & Wildlife Services (NPWS) (ND) *NPWS Map Viewer* [Online] - Available at: http://webgis.npws.ie/npwsviewer/

National Roads Authority (NRA) (2008) *Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes*

Transport Infrastructure Ireland (TII) (2013) *Notes for Guidance on the Specification for Road Works Series NG 600 - Earthworks*

von Post L., Granlund L.E., and Granlund L. (1926) *Södra Sveriges Torvtillgånger, I*. Sver.Geo. Unders. C35, 19 (2)