

## 10 SOILS AND GEOLOGY

### 10.1 INTRODUCTION

This chapter assesses the effects of the Proposed Development on the soils and geology of the Site. Where negative effects are predicted, the chapter identifies appropriate mitigation strategies therein. The assessment assesses the potential effects during the following phases of the Proposed Development:

- Construction of the Development
- Operation of the Development
- Decommissioning of the Development (final phase)

The Development refers to all elements of The Project for the construction and operation of the proposed Kellystown Wind Farm (**Chapter 2: Description of the Proposed Development**).

Soils and Geology assessment for The Project has been an iterative process undertaken over a period of over 2 years, involving a number of periods of fieldwork. Following appraisal of initial baseline constraints, the proposed wind farm layout has been subject to more detailed assessments. After each of these phases of detailed assessment the wind farm layout has been further adjusted and altered to deal with changes that result from increasingly more accurate ground models.

This assessment has been undertaken for, and is applicable to, all the different options for wind farm design flexibility being sought under this Planning Application.

This chapter of the EIAR is supported by Figures provided in Volume III and by the following Technical Appendix documents provided in Volume IV of this EIAR:

**Technical Appendix 10.1:** 2200-23A Kellystown Wind Farm - Desktop Study and Walkover Survey for Preliminary Determination of Ground Conditions & 2200-23B Kellystown Wind Farm - Preliminary SI Report rev01.

A Construction Environmental Management Plan (CEMP) is appended to the EIAR in **Technical Appendix 2.1**. In the event permission is granted for the Proposed Development, the final CEMP will address the requirements of any relevant planning conditions, including any additional mitigation measures which are conditioned. It will include all of the mitigation prescribed within the EIAR and will be implemented in full. A summary of the mitigation measures is included in **Technical Appendix 20.1**.

This chapter is an EIA of the Proposed Development on Soils and Geology. A full description of the Proposed Development is outlined in section 2.3 of Chapter 2 and includes one TDR (the Proposed TDR) and one GCR (the proposed GCR). Other viable GCR/TDRs have also been assessed as part of the EIAR. Although planning permission is not being sought for these viable routes (GCR option 2 and TDR option 2 and TDR option 3) they have been fully assessed. All EIA aspects of GCR option 2 and TDR option 2 and 3 are documented in Appendix 3.1. Refer to section 7 of Appendix 3.1 for the Soils and Geological assessment of GCR option 2 and TDR option 2 and 3.

### 10.1.1 Assessment Structure

In accordance with the revised EIA Directive and EPA EIAR Guidelines 2022 the structure of this Soils and Geology chapter is as follows:

- Details of the assessment methodology utilised for desk and field studies.
- Description of baseline conditions at the Site and an outline of the likely evolution, where the Proposed Development not to proceed, as far as natural changes from the baseline scenario are concerned.
- Identification and assessment of effects to soils and geology associated with the Proposed Development, during the construction, operational and decommissioning phases.
- Mitigation measures to avoid or reduce the effects identified.
- Identification and assessment of residual effect of the Proposed Development after applying mitigation measures.
- Identification and assessment of cumulative effects.

### 10.1.2 Statement of Authority

This Chapter of the EIAR has been prepared by John Whiteford, Whiteford Geoservices Limited (WGL).

John Whiteford BSc (Hons) Geophys MIOSH MEAGE FGS has more than 25 years of experience in the field of earth sciences, geotechnical engineering, and management. His academic qualifications are a BSc with Honours in Geophysics from Edinburgh University, with fellowship of the Geological Society and memberships of The European Association of Geoscientists and Engineers and The Institute of Safety and Health.

Commencing work with Kirk McClure Morton (Consulting Engineers) in Belfast since then has been engaged in full-time consultancy for the past 20 years and since 2000 trading as Whiteford Geoservices Limited.

The company has a staff of more than 10 professional and technical personnel and has completed in excess 2000 contracts for clients within the construction and mineral exploration sectors where they have built up a recognised level of specialist experience, particularly in the field of Wind Energy.

Working within the British Isles, in Europe and worldwide, the company has been involved in more than 120 wind power projects, where our services have been sought in relation to geotechnical design, geophysical design, peat landslide hazard assessment, karst landscape assessment, electrical earthing design, thermal cable design and other soils and geology related aspects.

Other contributors to the assessment are as follows:-

The field work and interpretative reporting was designed and executed by members of the following project team:

1. Mr Ryan Calvert BSc (Hons) Forensic Science – Technical Director. (10 years' experience).
2. Mr James Ardern BSc (Hons) Geology, Senior Project Geologist. (15 years experience)
3. Mr Armand Tollas BSc (Hons) Environmental Science – Project Engineer. (12 years' experience).
4. Mr Jaime Stothers– Field Engineer. (9 years' experience).

## 10.2 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

### 10.2.1 Assessment Methodology

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

- Characterise the topographical, geological and geomorphological regime of the Site from the data acquired through desk study and onsite surveys.
- Consider ground stability issues as a result of the Proposed Development, its design and methodology of construction.
- Assess the combined data acquired and evaluate any likely effects on the soils, geology and ground stability aspects of the environment.
- If effects are identified, consider measures that would mitigate or reduce the identified effect.
- Present and report these findings in a clear and logical format that complies with EIAR reporting requirements.

### 10.2.2 Relevant Legislation and Guidance

This assessment complies with the EIA Directive as amended, which requires the assessment of likely significant effects on the environment for certain types of major development before development consent is granted. This assessment was undertaken in accordance with the following Irish legislation (transposition of the aforementioned directive):

- SI No. 296 of 2018: European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018.
- SI No. 30 of 2000: Planning and Development Act 2000 (as amended).
- SI No. 600 of 2001: Planning and Development Regulations 2001 (as amended)
- SI No. 4 of 1995: The Heritage Act 1995 (as amended)
- SI No. 33 of 2000: The Wildlife (Amendment) Act, 2000 (as amended)

The Louth County Development Plan (2021-2027) has also been considered as part of the EIA process.

This assessment has been prepared in accordance with the following guidance documents, which take account of the aforementioned legislation:

- Department of Housing, Local Government and Heritage (2006) Wind Energy Development Guidelines

- Department of Housing, Planning and Local Government (2019) Draft Revised Wind Energy Guidelines
- Environmental Protection Agency (EPA) (2003) Advice Notes for Preparing Environmental Impact Statements
- EPA (2022) Guidelines on the information to be contained in Environmental Impact Assessment Reports – May 2022 (Supersedes 1997, 2002 and 2017 versions)
- Institute of Geologists of Ireland (IGI) (2002) Geology in Environmental Effect Statements – A Guide
- IGI (2013) Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements
- Irish Wind Energy Association (IWEA) (2012) Best Practice Guidelines for the Irish Wind Energy Industry
- 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
- CIRIA (2006) Control of Water Pollution from Linear Construction Projects – Technical Guidance
- BSI (2015 + A1 2020) Code of Practice for Site Investigations – BS 5930
- Peat Landslide Hazard and Risk Assessment: Prepared for Energy Consents Unit, Scottish Government Second Edition 2017, hereafter referred to as “the Scottish Guidance”.
- NPWS (2015) National Peatlands Strategy

### 10.2.3 Desk Study

The study area is defined as the region within which changes to the soils and geology environment associated with The Project could reasonably impact sensitive receptors. All of potential effects of The Project have a limited zone of influence and for these the study area has been limited to 1km from the Site boundary. However, there is also the potential for the zone of influence to be greatly extended, for instance soil contamination by watercourses. In such a case effects can potentially impact receptors downstream, in excess of 1km from the Site. For this reason, sensitive receptors within 10km have been included in the study area.

Desk study information has been interpreted to establish the broad baseline conditions within the study area ahead of the site investigations and has been employed for both preliminary layout design and for design of the site investigation works.

The desk study consisting of a review of all available datasets, information, and literature resources relevant to the Site has been completed and included the following sources:

- Geological Survey of Ireland – Geological Heritage site mapping ([www.gsi.ie](http://www.gsi.ie)) – accessed 18/10/2024
- Geological Survey of Ireland – Groundwater, Landslides, Aggregate Potential and Geology ([www.gsi.ie](http://www.gsi.ie)) – accessed 18/10/2024
- Environmental Protection Agency database ([www.epa.ie](http://www.epa.ie)) – accessed 18/10/2024  
This involved the following components:
  - Acquire and compile relevant available maps of the Proposed Development.
  - Study and assess the proposed locations of Turbines and Site Tracks, 38kV Substation and Grid Route relative to available data on Site topography and slope gradients.
  - Study and assess the proposed locations of Turbines and Site Tracks, 38kV Substation and Grid Route relative to available data on Site soils, subsoil and bedrock geology.
  - Screen for and assess the potential for Peat Landslide Hazard Assessment (PLHA),
  - Overlay Ordnance Survey of Ireland (OSI) 1:250,000, 1:50,000 and 1:10,560 (6") maps with AutoCAD plan drawings.
  - Overlay Geological Survey of Ireland (GSI) Geology maps (1:100,000) to determine Site bedrock geology and the presence of any major faults or other anomalies.
  - Overlay Geological Survey of Ireland (GSI) Landslide Susceptibility maps to determine Site landslide susceptibility risk classification.
  - Overlay Environmental Protection Agency (EPA) and Teagasc (Agricultural Agriculture & Food Authority) Soils and Subsoil maps (1:50,000) to determine categories of soils and subsoil at the Site.
  - Search of the GSI landslide database for records of landslide mass movement events at and near the Study Area.

## 10.2.4 Field Work

### 10.2.4.1 Geotechnical Investigations, Site Walk Over and Observations

Following completion of the desk study, an initial Site walkover survey was undertaken by John Whiteford, Jaime Stothers in December 2022 and then following revisions to the layout a second ground investigation campaign was undertaken by James Arden, in February 2024.

The works undertaken were as follows:-

- A site visit and walkover assessment of the main wind farm infrastructure and grid connection route. (December 2022)
- Bedrock and sub-soils outcrop logging and characterisation at proposed turbine locations. (December 2022)
- 12 Nr. machine excavated trial holes at proposed turbine / substations locations to a maximum depth of 3.70m below existing ground level. (5 nr in December 2022 and 7nr in February 2024)
- Determination of soil and peat characteristic at each turbine consisting of probing and trial pitting to determine soil / peat thickness, shear vane testing and an assessment of peat decomposition (if found to be present) according to Von Post. (December 2022 and February 2024)
- Reconnaissance to identify sensitive receptors with respect to potential peat, soils landslide. (December 2022)
- Identification of potential pre-failure indicators, failure preconditions and potential triggers for soil stability within the vicinity of the main infrastructure. (December 2022)  
Preliminary determination of superficial soils at the main infrastructure. (December 2022 and February 2024)

This preliminary assessment of peat soils determined peat to be less than 0.5m in thickness, where present. Consequently, peat stability is **not** a particular risk with respect to the Proposed Development. No further peat assessment is required, as per the recommendations contained in Peat Landslide Hazard and Risk Assessment: Prepared for Energy Consents Unit, Scottish Government Second Edition 2017, (the Scottish Guidance).

## 10.2.5 Evaluation of Potential Effects

### 10.2.5.1 Sensitivity

Sensitivity is defined as the potential for a receptor to be significantly affected by a proposed development (EPA, 2022). The EPA provides guidance on the assessment methodology, including defining general descriptive terms in relation to magnitude of effects however, in terms of qualifying significance of the receiving environment the EPA guidance also states that:

*“The value of the superficial/ solid geology should be identified to allow an assessment of the effect of the proposed development to be considered adequately” (EPA, 2015)*

Potential effects arising from 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. To facilitate the qualification of geological attributes, guidance specific to land and soils as set out by National Roads Authority (NRA), and guidance specific to landscape as set out by Scottish National Heritage (SNH) has been used in conjunction with EPA guidance.

The following table presents rated categories and criteria for rating Site attributes (NRA (2008) Environmental Impact Assessment of National Road Schemes).

**Table 10.1: Sensitivity Criteria for Rating Site Attributes – Soils and Geology Specific**

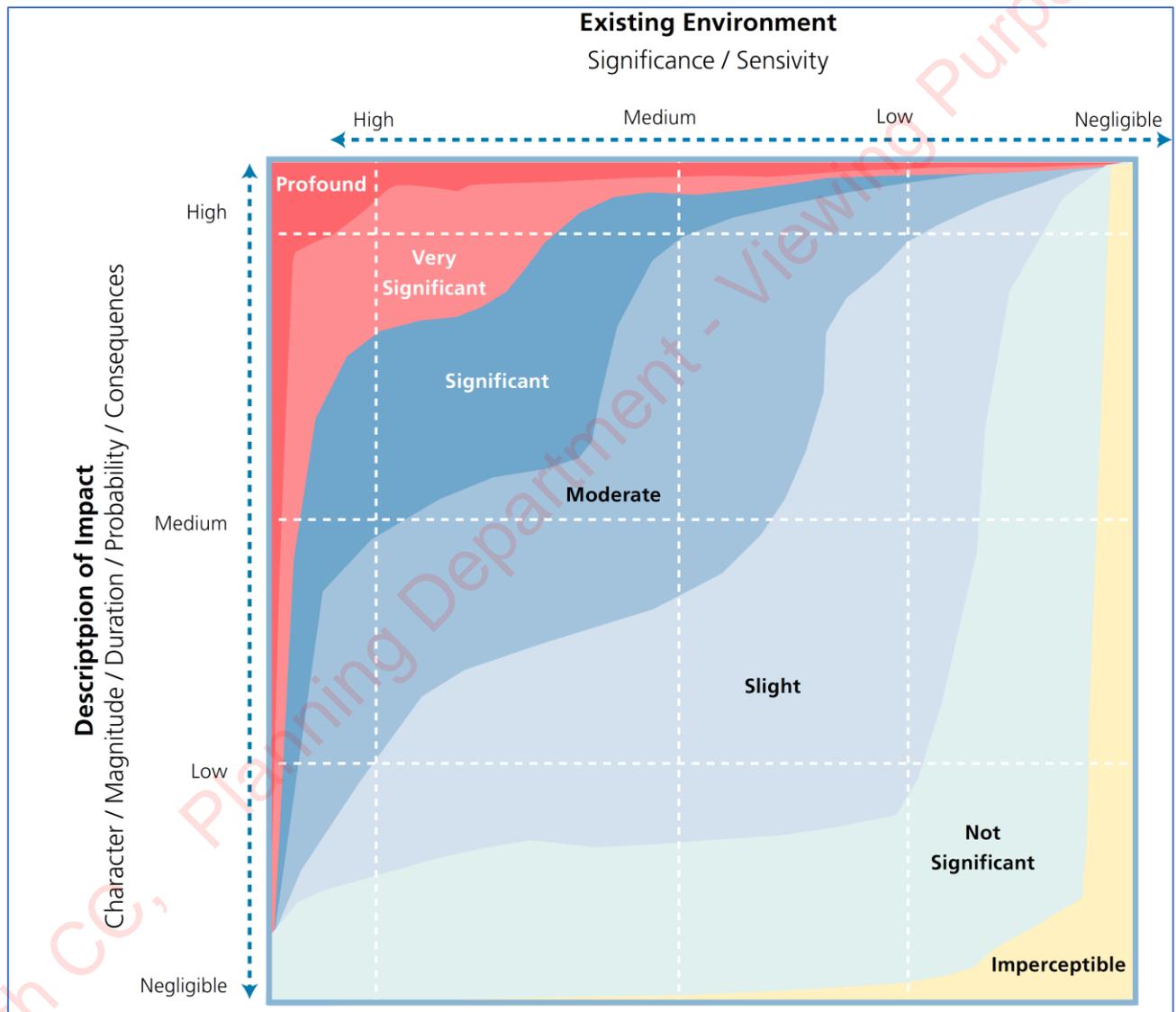
Importance	Criteria	Typical Examples
Very High	Attribute has a high quality, significance or value on a regional or national scale Degree or extent of soil contamination is significant on a national or regional scale Volume of peat and/or soft organic soil underlying route is significant on a national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

\*relative to the total volume of inert soil disposed of and/or recovered

The sensitivity of the receiving geological environment is defined by the baseline quality, as well as its potential to absorb change and for substitution.

The diagram shown in **Figure 10.1** presents how comparison of the character of the predicted effect to the sensitivity of the receiving environment can determine the significance of the effect (EPA, 2022).

**Figure 10.1: Comparison of the Character of the Predicted Effect to the Sensitivity of the Receiving Environment (EPA, 2022)**



**10.2.5.2 Magnitude**

The magnitude of potential effects arising as a product of the Proposed Development are defined in accordance with the criteria provided by the EPA, as presented in the following table (EPA, 2022). These descriptive phrases are considered general terms for describing potential effects of the Proposed Development, and provide for considering baseline trends,

for example; a *Moderate* effect is one which is consistent with the existing or emerging trends.

**Table 10.2: Describing the Magnitude of Effects**

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

In terms of soils and geology, magnitude is qualified in line with relevant guidance, as presented in the following table (NRA, 2008). These descriptive phrases are considered development specific terms for describing potential effects of the Proposed Development, and do not provide for considering baseline trends. They are only utilised to qualify effects in terms of a weighting relative to Site attribute importance and scale.

**Table 10.3: Qualifying the Magnitude of Effect on Soil and Geological Attributes**

Magnitude of Effect	Description	Example
Large Adverse	Results in a loss of attribute.	Removal of the majority (>50%) of geological heritage feature.
Moderate Adverse	Results in effect on integrity of attribute or loss of part of attribute.	Removal of part (15-50%) of geological heritage feature.
Small Adverse	Results in minor effect on integrity of attribute or loss of small part of attribute.	Removal of small part (<15%) of geological heritage feature.
Negligible	Results in an effect 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.

### 10.2.5.3 Significance Criteria

Considering the above definitions and rating structures associated with sensitivity, attribute importance, and magnitude of potential effects, rating of significant environmental effects is done in accordance with relevant guidance, as presented in the table below which is, in effect, a risk matrix.

This matrix qualifies the magnitude of potential effects, based on the weighting of these effects in light of their importance and/or sensitivity of the receiving environment. In terms of Soils and Geology, the general terms for describing potential effects (**Table 10.3: Describing the Magnitude of Effects**) are not linked directly with the Proposed Development specific terms for qualifying potential effects (**Table 10.4: Qualifying the Magnitude of Effect on Soil and Geological Attributes**) therefore, both descriptive (**Table 10.3**) and qualifying (**Table 10.4**) terms are used in describing potential effects of the Proposed Development. This is largely driven by the likely localised characteristic of potential effects arising as a product of the Proposed Development in terms of Soil and Geology, and the separation of land areas based on baseline conditions (**Section 10.4**).

**Table 10.4: Weighted Rating of Significant Environmental Effects**

Sensitivity (Importance of Attribute)	Magnitude of Effect			
	Negligible (0-2%)	Small (2-15%)	Moderate (15-50%)	Large (>50%)
<b>Very High</b>	Slight	Significant / Moderate	Profound / Significant	Profound
<b>High</b>	Slight / Imperceptible	Moderate / Slight	Significant / Moderate	Profound / Significant
<b>Medium</b>	Imperceptible	Slight	Moderate	Significant
<b>Low</b>	Imperceptible	Imperceptible	Slight	Slight / Moderate

#### 10.2.5.4 Scoping Responses and Consultation

Information has been provided by a number of consultee organisations during the assessment, and this is summarised in **Table 10.5**. The response to each point raised by consultees is also presented within the table, demonstrating where the design of the Proposed Development has addressed responses to specific issues indicated by respective consultees.

**Table 10.5: Scoping Responses and Consultation**

Consultee	Type and Date	Summary of Consultee Response With Relevance to This Chapter	Addressed
Geological Survey of Ireland	Scoping response received 9th August 2023.	<p><b>Geoheritage</b>  <i>A national inventory of geoheritage sites known as County Geological Sites (CGSs) is managed by the Geoheritage Programme of Geological Survey Ireland. CGSs, as adopted under the National Heritage Plan, include sites that are of national importance which have been selected as the very best examples for NHA (Natural Heritage Areas) designation. NHA designation will be completed in partnership with the National Parks and Wildlife Service (NPWS). CGSs are now routinely included in County Development Plans and in the GIS of planning departments, to ensure the recognition and appropriate protection of geological heritage within the planning system. CGSs can be viewed online under the Geological Heritage tab on the online Map Viewer</i></p> <p><i>The audit for Co. Waterford was carried out in 2011. The full report details can be found at here. Our records show that there are no CGSs in the vicinity of the proposed wind farm and turbine delivery route.</i></p> <p><b>Geological Mapping</b>  <i>Geological Survey Ireland maintains online datasets of bedrock and subsoils geological mapping that are reliable and accessible. We would encourage you to use these data which can be found here, in your future assessments.</i></p> <p><b>Geohazards</b>  <i>Geohazards can cause widespread damage to landscapes, wildlife, human property and human life. In Ireland, landslides, flooding and coastal erosion are the most prevalent of these hazards. We recommend that geohazards be taken into consideration, especially when developing areas where these risks are prevalent, and we encourage the use of our data when doing so. Landslides are common in areas of peat, rock near surface and in fine to coarse range materials (such as glacial tills), areas which are found within the proposed wind farm area. The Landslide Susceptibility map indicates variable landslide susceptibility within the wind farm boundary area, including areas of 'Moderately High' to 'High' susceptibility. Geological Survey Ireland has information available on landslides in Ireland via the National Landslide Database and Landslide Susceptibility Map both of which are available for viewing on our dedicated Map Viewer. Associated guidance documentation relating to the National Landslide Susceptibility Map is also available.</i></p> <p><b>Natural Resources (Minerals/Aggregates)</b>  <i>Geological Survey Ireland provides data, maps, interpretations and advice on matters related to minerals, their use and their development in our Minerals section of the website. The Active Quarries, Mineral Localities and the Aggregate Potential maps are available on our Map Viewer.</i>  <i>We would recommend use of the Aggregate Potential Mapping viewer to identify areas of High to Very High source aggregate potential within the area. In keeping with a sustainable approach, we would recommend use of our data and mapping viewers to identify and ensure</i></p>	Section 10.3

Consultee	Type and Date	Summary of Consultee Response With Relevance to This Chapter	Addressed
		<p><i>that natural resources used in the proposed wind farm development are sustainably sourced from properly recognised and licensed facilities, and that consideration of future resource sterilization is considered.</i></p>	
<p>Health Service Executive</p>	<p>Scoping response received 11th August 2023.</p>	<p><b>Land, Soils and Geology</b>  <i>The scoping report refers to an assessment of land, soils and geology and within that, reference is made to the consideration of ground stability issues.</i>  <i>A detailed assessment of the current ground stability of the site for the proposed wind farm and all proposed mitigation measures should be detailed in the EIAR. The assessment should include:</i>  <i>the impact construction work may have on the future stability of ground conditions, taking into consideration extreme weather events, site drainage and the potential for soil erosion.</i>  <i>Information should be provided on the make and model of the turbines and on construction details for the turbine foundations, including the depth and volume of concrete required. An accurate assessment of the potential impacts of the foundations on water quality and peat stability cannot be undertaken without this information.</i>  <i>Reference is made to a peat slide which occurred near Ballybofey in Co. Donegal on November 13th, 2020, which may have been linked to construction activity at Meenbog Wind Farm. Potential impacts on water supply associated with contamination following a peat slide include sedimentation and alteration of pH levels.</i>  <i>The Environmental Health Service recommends that a detailed Peat Stability/Geotechnical Assessment should be undertaken to assess the suitability of the soil for the proposed development. The EIAR should include provision for a peat stability monitoring programme to identify early signs of potential bog slides ('pre-failure indicators' see the Scottish Government's 'Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Developments 2017)</i>  <a href="https://www.gov.scot/binaries/content/documents/govs-cot/publications/advice-and-guidance/2017/04/peat-landslide-hazard-risk-assessments-best-practice-guide-proposed-electricity/documents/00517176-pdf/00517176-pdf/govscot%3Adocument/00517176.pdf">https://www.gov.scot/binaries/content/documents/govs-cot/publications/advice-and-guidance/2017/04/peat-landslide-hazard-risk-assessments-best-practice-guide-proposed-electricity/documents/00517176-pdf/00517176-pdf/govscot%3Adocument/00517176.pdf</a></p> <p><b>Cumulative Impacts</b>  <i>All existing or proposed wind farm developments in the vicinity should be clearly identified in the EIAR.</i>  <i>The impact on sensitive receptors of the proposed development combined with any other wind farm developments in the vicinity should be considered. The EIAR should include a detailed assessment of any likely significant cumulative impacts of the proposed renewable energy development.</i></p>	<p>Section 10.3 and Section 10.5.6</p>

### 10.2.6 Limitations and Technical Difficulties

Limitations and their effect in relation to this soils and geology assessment are outlined in **Table 10.6**, below.

**Table 10.6: Limitations**

Limitation	Description	Significance of Limitation for Assessment
Density of Ground Information	<p>The density of ground information varies in relation to the quantity of exploratory holes and geophysical data points from which the soils and geology assessment is based.</p> <p>This means that actual thicknesses of soil and depth to competent rock can vary within a range, which has been defined by detailed site investigation.</p> <p>The density of the ground information collected for Kellystown Wind Farm depends on the significance of the effect that each element of The Project will have on the Soils and Geology Environment. This means that recommendation for Structures such as wind turbines substation buildings and other structures are based on the most precise ground information, whilst elements with lower effects (such as access tracks and hardstands) have a lower density of ground information informing their design.</p> <p>Although, the basis of the recommendations in each case will not change, the specifics in relation to soil thickness, competent rock thickness and soil / rock characteristics will vary within a range.</p>	Slight, Adverse
Measurement Accuracy	<p>Positioning of each exploratory hole or geophysical data point.</p> <p>Accuracy for these is + / - 300mm in the X/Y plane and +/- 100mm in the Z plane.</p>	Slight, Adverse
Effects to the Proposed Development from Unknown Aspects external to The Project	<p>All reasonable effort has been made to identify aspects external to the site that have the potential to impact the Proposed Development. This identification process is based on best practice and past experience. However, there remains the potential for unknown causal factors, that exist outside both the Site and the range of best practice / past experience, to adversely affect the Project.</p>	Slight, Adverse

No Technical Difficulties arose out of the fieldwork undertaken to prepare this assessment.

## 10.3 BASELINE DESCRIPTION

### 10.3.1 Introduction

An initial investigation of the existing land, soils and geology characteristics of the study area was conducted by undertaking a desk study, consultation with relevant authorities and Site-based fieldwork surveys.

The study area is defined as the region within which changes to the soils and geology environment associated with The Project could reasonably impact sensitive receptors. All of potential effects of The Project have a limited zone of influence and for these the study area has been limited to 1km from the Site boundary. However, there is also the potential for the zone of influence to be greatly extended, for instance soil contamination by watercourses. In such a case effects can potentially impact receptors downstream, in excess of 1km from the Site. For this reason, sensitive receptors within 10km have been included in the study area

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.

### 10.3.2 Site Description

The Proposed Development Site is located within an area of farmland, forestry and scrubland, and is located within the townlands of Brittas, Brownstown, Cartanstown, Drumshallon, Gallstown, Groom, Kearneystown, Keeverstown, Piperstown, Rokeby, Stonehouse and Swinestown. The site is located 8.3km north of Drogheda, 23.6km South of Dundalk and 50km North of Dublin.

Ground surface elevations vary between approximately 91m to 126m above Ordnance Datum (Malin Head).

The land usage across the number of land holdings which make up the Site, consists of agricultural grazing land for cattle, equestrian facilities, portions of scrubland and a small area of forestry.

### 10.3.3 Turbine Component Delivery Route / Haul Route

The proposed turbine delivery haul route, of approximately 265km, from Galway Port is via a combination of local roads, national roads and motorways, as far as the wind farm entrance. Refer to **Table 2.5**.

A total of 15 areas on the haul route will require temporary works to the public road to facilitate delivery of turbine components, Refer to **Table 2.6**.

One further area will require works in 3<sup>rd</sup> party lands and will require the construction of a new section of road. Refer to **Table 2.7**.

#### 10.3.4 Grid Route

The substation at Kellystown will connect via 17.78km of underground 38kV cable to the existing Drybridge 110kV Substation located in the townland of Tullyallen, from where it will connect by existing connection to the National Grid.

#### 10.3.5 Bedrock Geology

A study was made of available geological information for the area (GSI Online Database). This study indicated that the following natural geology is present across the site of the Proposed Development;

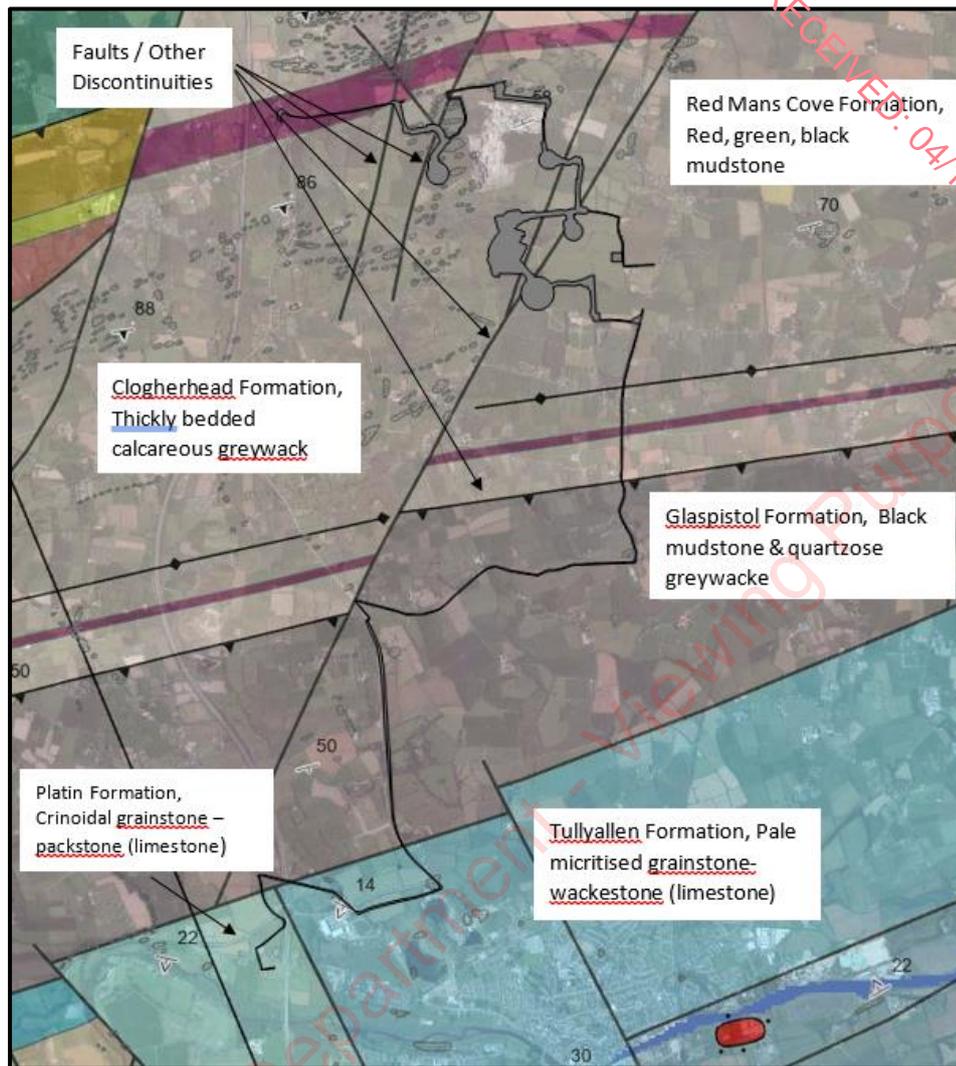
- Thickly bedded calcareous greywacke (siltstone) which outcrops within the western portion of the site
- Glacial Till (derived from Lower Palaeozoic sandstones and shales)
- Alluvium (present in river valley bottoms)
- Cutover Raised Bog (isolated discrete locations)

The wind farm site is immediately underlain by the Clogherhead Formation and consists of, thickly bedded calcareous greywacke.

Also present just outside the Site, north east of the site boundary, is the Red Mans Cove Formation which consists of, red, green, black mudstone.

A series of three faults also bisect the wind farm site, trending in an approximately north north east – south south west direction potentially affecting the quality of the subsurface rock formation at WTG02, WTG04 and WTG05.

Faults have the potential to result in highly fractured and deeply weathered bedrock and / or the channelling of groundwater flow.



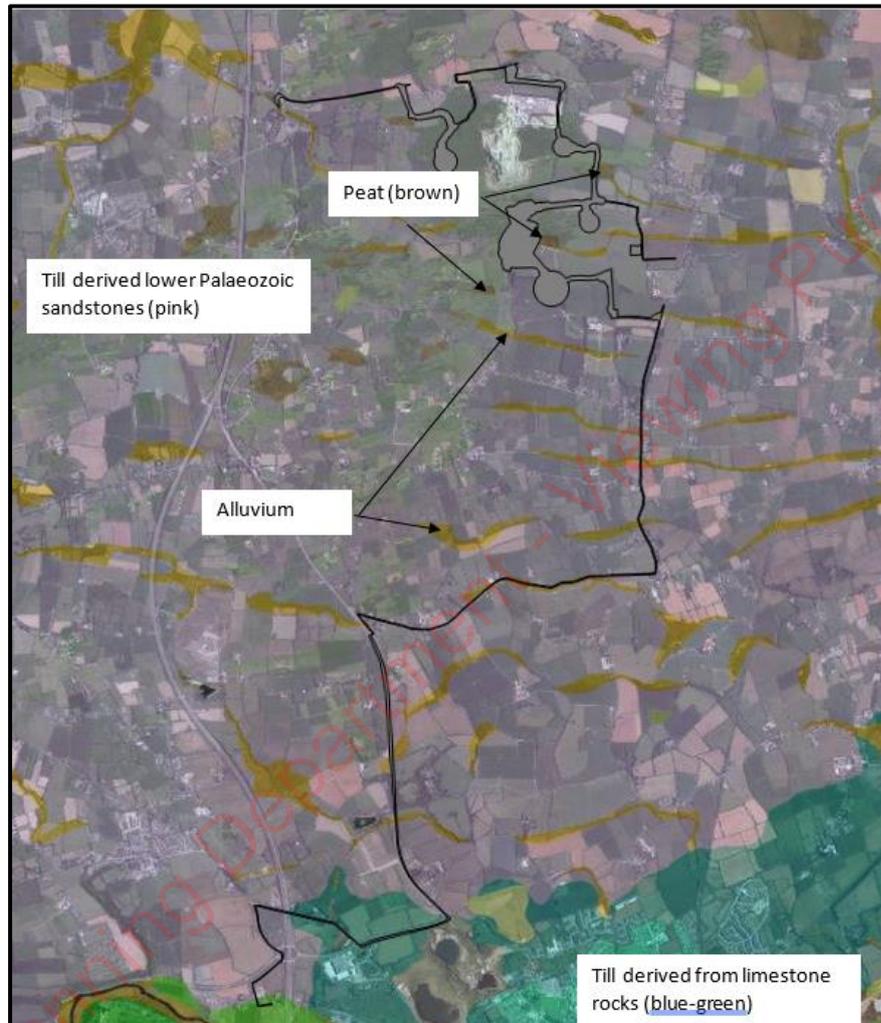
**Figure 10.2** – Bedrock Solid Geology (Reproduced courtesy of GSI Datasets Public Viewer).

### 10.3.6 Soils and Subsoils

A study was made of available geological information for the area (GSI Online Database). This study indicated that the following natural geology is present across the site of Kellystown Wind Farm;

- Topsoil
- Alluvium (close to Drumshallon Lough and associated watercourse)
- Isolated Peat (Raised Bog) at least 100m from the main wind farm infrastructure, overlying,
- Glacial Till (sands and gravels / boulder clay)

Superficial soils present within the wind farm consist of thin glacial till soils overlying shallow, often outcropping greywacke rock to the north and west. Thicker glacial tills derived from Lower Palaeozoic sandstones are present towards the south and east of the site. Alluvium is present throughout the Site with some isolated area of peat also indicated outside the proposed construction footprint.



**Figure 10.3 – Superficial Geology** (Reproduced courtesy of GSI Datasets Public Viewer)

#### 10.3.6.1 Peat Depths

Peat Landslide Hazard screening was undertaken at the main structures, within the redline boundary shown above. The results of these peat thickness measurements are given in **Table 10.7** below.

**Table 10.7: Peat Depth Distribution by Category**

Peat Depth Category	Number of Survey Points
A – Rock/Very Shallow Peat/Topsoil (0.0-0.5m)	9
B - Shallow (0.5-1.5m)	0
C - Moderately Deep (1.5-2.5m)	0
D - Deep (2.5-4.0m)	0
E - Extremely Deep (>4m)	0
<b>Total</b>	<b>9</b>

No peat was recorded during these assessments and all organic soils encountered were classified as Topsoil.

### 10.3.6.2 Mineral Soils

Trial hole excavations undertaken during the site investigations were completed at each of the 5 No. proposed wind turbine locations and at the substation / battery energy storage facility.

The results of these peat thickness measurements are given in **Table 10.8** below.

**Table 10.8: Summary of Sub-surface Lithology at Proposed Development Locations**

Infrastructure Location	Land Use	Topsoil Thickness (m)	Total Topsoil and Mineral Soil Thickness (m)	Competent Rock Depth (m)	Summary Soil Description
Turbine T1	Agriculture	0.40	0.80	1.20	Medium dense, brown, slightly gravelly, clayey SAND
Turbine T2	Agriculture	0.10	0.10	0.70	None / Absent
Turbine T3	Agriculture	0.20	1.00	1.50	Probable MADE GROUND: Dense, COBBLES and BOULDERS
Turbine T4	Agriculture	0.30	2.00	>3.00	Stiff, greyish brown, slightly gravelly CLAY with a low cobble and boulder content
Turbine T5	Forestry	0.40	2.80	>3.00	Medium dense to dense, orangish brown mottled grey, gravelly, very clayey, fine to coarse SAND with a medium cobble and low boulder content.
Substation	Agriculture	0.30	>1.80	>1.80	Stiff, greyish brown, slightly gravelly CLAY with

Infrastructure Location	Land Use	Topsoil Thickness (m)	Total Topsoil and Mineral Soil Thickness (m)	Competent Rock Depth (m)	Summary Soil Description
					a medium cobble and boulder content

### 10.3.7 Geological Resource Importance

The Geological Survey of Ireland (GSI) website for this area shows that there is an active quarry immediately adjacent to the Site. The nearest active quarries are as follows:

1. Active Quarry (Greywacke – Hard rock aggregate), operated by Kilsaran Concrete Ltd, 0.1 km north and of Kellystown Wind Farm at Gallstown, Co. Louth. This quarry employs blasting to remove bedrock. Given its proximity, further detailed analysis has been undertaken to predict the effect of this process to the wind farm throughout its operation. Refer to “Kellystown Wind Turbine Generators, Ground Vibration and Air Overpressure Blast Monitoring Interim Report 1”, August 2024, WSP, **Chapter 13**, Noise and Vibration.
2. Mullaghcrone Quarry (Limestone – Hard rock aggregate), operated by Roadstone Ltd, 11 km south of Kellystown Wind Farm.

No records of shafts or adits associated with mineral exploration have been recorded within the immediate vicinity.

### 10.3.8 Sites of Geological Heritage

The Geological Survey of Ireland (GSI) also maintains a database for known Geological Heritage Sites in Ireland. This database was accessed on 11th October 2024 and review of its published contents has determined that the following audited Geological Heritage Sites are present in the vicinity.

**Table 10.9A: Audited Geological Site at Port Raised Beach**

Site Code	LH025
Site Name	Port Raised Beach (4.5 km North East)
IGH Theme 1	IGH13
IGH Theme 2	
County	Louth
Description	A wide, flat-topped feature adjacent to the shoreline between Clogherhead and Dunany point
Designation	CGS

Geological	The feature is a beach deposited in the locality when sea level was higher than it is today
Report	
Coordinates (IG)	313884, 287393
Coordinates (ITM)	713810.091, 787408.152

**Table 10.9B: Audited Geological Site at Oriel Brook**

Site Code	LH025
Site Name	Oriel Brook (6.5km West)
IGH Theme 1	IGH2
County	Louth
Description	A stream section with small exposures along the banks, within dense rhododendron plantations
Designation	CGS
Geological	Deep-water fossil assemblage (brachiopods and trilobites), one of the youngest faunas in the region
Report	
Coordinates (IG)	300816, 284338
Coordinates (ITM)	700744.970, 784353.760

**Table 10.9C: Audited Geological Site at Ardee-Newtown Bedform Field**

Site Code	LH001
Site Name	Ardee-Newtown Bedform Field (6.5km North West)
IGH Theme 1	IGH7
County	Louth
Description	This is a field of subglacial bedforms and includes drumlins, crag-and-tails and ribbed moraines
Designation	CGS
Geological	The field is unusual in that a huge variety and range of sizes of features are found
Report	
Coordinates (IG)	296333, 287741
Coordinates (ITM)	696262.805, 787755.443

**Table 10.9D: Audited Geological Site at Collon Quarry**

Site Code	LH013
Site Name	Collon Quarry (8.5km South West)
IGH Theme 1	IGH4
County	Louth
Description	This site is a disused quarry
Designation	CGS.
Geological	Andesitic brecciated lavas that are part of the Grangegeeth Terrane within the Iapetus Suture zone
Report	
Coordinates (IG)	299873, 281453
Coordinates (ITM)	699802.145, 781468.705

**Table 10.9E: Audited Geological Site at Castlebellingham Morainic Complex**

Site Code	LH010
Site Name	Castlebellingham Morainic Complex (8km North)
IGH Theme 1	IGH7
County	Louth
Description	This is an area of distinctive hummocky topography just south of Castlebellingham
Designation	CGS.
Geological	This is a large accumulation of sands and gravels deposited at the edge of the retreating ice margin
Report	
Coordinates (IG)	305177, 293395
Coordinates (ITM)	705105.720, 793408.287

**Table 10.9F: Audited Geological Site at Linns Moraine**

Site Code	LH022
Site Name	Linns Moraine (9km North)
IGH Theme 1	IGH4
County	Louth
Description	A distinctive 2km-long moraine ridge c. 10m-15m high over most of its extent
Designation	CGS.
Geological	This records ice-margin dynamics after the ice withdrew a short distance from Dunany Point

Report	
Coordinates (IG)	308038, 294456
Coordinates (ITM)	707965.796, 794469.307

**Table 10.9G: Audited Geological Site at Dundalk Bay**

<b>Site Code</b>	<b>LH018</b>
Site Name	Dundalk Bay (8.5km North)
IGH Theme 1	IGH13
County	Louth
Description	Dundalk bay is a wide coastal embayment, incorporating wide expanses of coastal flats
Designation	CGS.
Geological	Extensive flats, associated beach, dune and slack features; beaches, salt marshes and headlands
Report	
Coordinates (IG)	309115, 302227
Coordinates (ITM)	709042.931, 802238.429

**Table 10.9H: Audited Geological Site at Clogher Head**

<b>Site Code</b>	<b>LH011</b>
Site Name	Clogher Head (8.5km East)
IGH Theme 1	IGH4, IGH11
County	Louth
Description	750-long coastal section with extensive foreshore outcrops and steep cliffs
Designation	CGS, may be recommended for Geological NHA
Geological	Lower Palaeozoic sediments displaying spectacular folds, intruded by numerous lamprophyre dykes
Report	
Coordinates (IG)	317184, 284079
Coordinates (ITM)	717110.146, 784094.510

**Table 10.9I: Audited Geological Site at Clogher Head Wave Cut Platform**

<b>Site Code</b>	<b>LH012</b>
Site Name	Clogher Head Wave Cut Platform (8km East)
IGH Theme 1	IGH7
County	Louth

Site Code	LH012
Description	Narrow flat areas found at the base of sea cliffs at Clogherhead
Designation	CGS.
Geological	Several wave-cut platforms in the cliffs at Clogher Head record falling post-glacial sea-levels
Report	
Coordinates (IG)	316776, 284119
Coordinates (ITM)	716701.950, 784134.357

**Table 10.9J: Audited Geological Site at Mell Quarry**

Site Code	LH023
Site Name	Mell Quarry (6km South)
IGH Theme 1	IGH1, IGH8, IGH7
County	Louth
Description	This is a complex of disused quarries adjacent to and northwest of the town of Drogheda
Designation	CGS.
Geological	The limestone at Mell Quarry is the best exposure of the Tullyallen Formation in the district
Report	
Coordinates (IG)	307347, 276350
Coordinates (ITM)	707274.653, 776366.742

**Table 10.9K: Audited Geological Site at Waterunderbridge - Dry Bridge**

Site Code	LH032
Site Name	Waterunderbridge - Dry Bridge (6.5km South)
IGH Theme 1	IGH1
County	Louth
Description	The site is mostly in a narrow, shallow gorge with the sometimes-dry streambed in it
Designation	CGS.
Geological	A karstic sinking river, a good example of classical karstic drainage, with sinks and risings
Report	
Coordinates (IG)	306109, 276380
Coordinates (ITM)	706036.759, 776396.889

**Table 10.9M: Audited Geological Site at Boyne Valley**

Site Code	MH011
Site Name	Boyne Valley (7.5km South West)
IGH Theme 1	IGH7
County	Meath
Description	River valley
Designation	CGS, may be recommended for Geological NHA
Geological	A glacial U-shaped valley with characteristic depositional and erosional features associated with ice flow and glacial meltwater
Report	
Coordinates (IG)	298078, 272904
Coordinates (ITM)	698007.753, 772921.558

### 10.3.9 Landslide Susceptibility

The GSI maintains a Landslide Susceptibility Map for Ireland. GSI landslide susceptibility mapping also indicates that the site has a predominantly low to moderately low susceptibility with respect to landslide risk within the red-line boundary.

This mapping also indicates isolated areas of moderately high landslide susceptibility indicated by the mapping database midway between WTG03 and WTG04. A review of local ground slopes within the landholding indicates that the isolated moderately high susceptibility coincides with steeper slopes associated with outcropping rock.

The isolated areas of cut-over peat coincides with slope gradients of <5 degrees to the horizontal and landslide susceptibility of low / moderately low.

The Geological Survey of Ireland (GSI) records show that the closest recorded landslide event was approximately 6km, south west of the site and not related to peat instability.

### 10.3.10 Peat Landslide Hazard Assessment

At the site of Kellystown Wind Farm there are isolated areas of peat, which were initially identified from GSI mapping and confirmed during the walk over survey.

A total of three such areas of cut-over raised bog are present in the Proposed Development area as follows: -

- Depression associated with Drumshallon Lough, centred on E=708135, N=783401

- Isolated depression centred on E=707668, N=782900
- Area centred on E=708695, N=784040

Only one such area of cut-over raised peat bog, extending to c. 5.27ha, is located within the Proposed Development. This area of peat is associated with Drumshallon Lough and occupies a locally low portion of land.

All turbine infrastructure is considered to be sufficiently distant from these fragments of bog (greater than 100m), so as to render any negative impact to the construction works negligible.

Preliminary screening has determined that peat landslide hazard is negligible due to the very limited thickness of peat soils within the construction zone.

#### 10.3.11 Sites of Designated Importance

The following designated sites are sensitive environmental receptors within the Study Area which have been assessed for potential effects arising from The Project.

The following areas which lie close to the Site are designated according to the Government of Ireland's EPA Map Viewer (accessed on 11<sup>th</sup> October 2024):

- Barmeath Woods Proposed NHA (Ref 001801 – 3km North)
- Mellifont Abbey Woods Proposed NHA (Ref 001464 – 5km West)
- Blackhall Woods Proposed NHA (Ref 001293 – 2.5km East)
- Castlecoo Hill Proposed NHA (Ref 001458 – 4km East)
- Clogherhead SAC (Ref: 001459 – 5km East)
- North West Irish Sea SPA (Ref: 004236 – 4.5km East)
- Boyne Estuary SPA (Ref 004080 – 6.5km South)
- Boyne Coast and Estuary SAC (Ref 001957 – 6.5km South)
- River Boyne and River Blackwater SAC (Ref 002299 – 7km South)
- King William's Glen Proposed NHA (Ref 001804 – 7km South West)

#### 10.3.12 Soil Contamination

There are no known areas of soil contamination within the Proposed Development site nor on the grid connection route. No evidence of soil contamination was noted during walkover surveys or the site investigation. As agricultural and forestry equipment is used across much of the Site it is possible that minor fuel spills and leaks have occurred locally in the past.

### 10.3.13 Site Investigations – Summary of Findings

**Table 10.10** presents a summary of the findings of the Soils and Geology Baseline together with preliminary design recommendations.

**Table 10.10: Summary of Site Investigation Findings and Recommendations**

Element Ref:	Element Assessed at Site Investigation Stage	Summary Soil Description
1A	Typical Soil Overburden (Wind Farm)	<p>A. Topsoil overlying thin sequence of medium dense gravelly SAND. Extremely weak rock at approx. 1.00m depth. Weak rock at &lt; 1.50m depth. (T01, T02 &amp; T03).</p> <p>B. Topsoil overlying sequence of stiff gravelly CLAY. Extremely weak rock at 2.00m to 2.80m. Weak rock at 3.00m depth (T04 &amp; T05)</p> <p>Topsoil overlying sequence of stiff gravelly CLAY at 0.30m depth. (SUBSTATION and BES).</p>
1B	Typical Soil Overburden and Bedrock (Grid Connection)	<p>MADE GROUND consisting of bituminous road surfacing and road base granular aggregate, overlying granular and GLACIAL TILL mineral soils.</p> <p>The bedrock geology mapped along the Grid Connection route consists of Clogherhead Formation (Greywacke), Red Mans Formation (Mudstone and Greywacke), Glaspistol (Mudstone and Greywacke) and Platin Formation (Crinoidal Limestone) between the Site and Drybridge 110kV Substation.</p> <p>Although the majority of the circuits will be laid within the superficial soils, some limited bedrock excavation is anticipated.</p>
2	Typical Overburden Thickness (m)	<p>T01 = 1.20m  T02 = 0.70m  T03 = 1.50m  T04 = 3.00m  T05 = 3.00m  SUBSTATION and BES = &gt; 1.80m</p>
2	Rock Type (Wind Farm)	<p>Non-calcareous grey Siltstone (Greywacke) pertaining to the Clogherhead Formation.</p> <p>Shallow siltstone / greywacke strata were found to be often extremely weak and easily rippable by the excavation plant deployed for the SI campaign.</p>
4	Rock Competence (Wind Farm)	<p>Rippable siltstone, highly decomposed, is generally EXTREMELY WEAK (i.e. 0.6 – 1 MPa or VERY WEAK (i.e. 1 to 5 MPa)</p> <p>Marginally rippable, highly weathered, siltstone is generally VERY WEAK to WEAK (i.e. 1 to 5 MPa)</p> <p>WEAK to MODEARTELY WEAK Siltstone (i.e. 5 to 12.5MPa) is generally non rippable, unless close to a joint or bedding plane</p> <p>MEDIUM STRONG Siltstone (i.e. 25 - 50 MPa) is non-rippable</p>
5	Typical Depth to Non Rippable Rock	<p>T01 = 1.20m  T02 = 0.70m  T03 = 1.50m  T04 = &gt;3.00m  T05 = &gt;3.00m  SUBSTATION and BES = &gt;1.80m</p>
6	Anticipated Wind Turbine Foundation Type	<p>T01 = Gravity Base within weathered rock  T02 = Gravity Base within weathered rock  T03 = Gravity Base within weathered rock</p>

Element Ref:	Element Assessed at Site Investigation Stage	Summary Soil Description
		T04 = Ground Improvement / Piled Foundation T05 = Gravity Base within weathered rock SUBSTATION = Raft, strip or pad foundations within the stiff glacial till soils
7	Slope Stability	T01 : FoS > 1.1 (Acceptable) T02 : FoS > 1.1 (Acceptable) T03 : FoS > 1.1 (Acceptable) T04 : FoS > 1.1 (Acceptable) T05 : FoS > 1.1 (Acceptable) SUBSTATION : FoS > 1.1 (Acceptable)
8	Karst Features	No "karst" features such as sinkholes, caves, cavities, voids or subterranean watercourses were located during the site investigation campaign.
9	Groundwater Observations	Weak flow at 2.0m (T04 - Mobile) Seepage at 2.6m (T05) - Mobile No groundwater encountered at T01, T02, T03 and SUBSTATION
10	GSI – Crushed Rock Aggregate Potential	According to Geological Survey Ireland, the Aggregate Potential for the Borrow Pit site can be summarised as follows: -  Very High – Majority of development area, including all turbine locations.  High – Low lying lands between T02 / T05 and public road along eastern boundary.
11	Predicted Performance as a construction aggregate	<b>Suitable.</b> Siltstone (Clogherhead Formation) is more suitable for use as construction fill. The extremely weak to weak shallow soils are highly weathered and although suitable as fill, its crushed aggregate may degrade rapidly to fine material where left exposed to weather and traffic.  Deeper unweathered siltstone is anticipated to produce a better-quality aggregate, although calcareous content may detract from its quality.

## 10.4 CHARACTERISTICS OF THE PROPOSED DEVELOPMENT

### 10.4.1 Engineering Design

The Proposed Development consists of 5 no. wind turbines and associated infrastructure including hardstands, met mast, access roads and substation, as well as temporary construction compounds. The Proposed Development also includes the underground grid connection route which will be hosted in the carriageway of the local road network from the Wind Farm site to the Drybridge 110 kV substation west of Drogheda. The engineering design for the Proposed Development is described in detail in Chapter 2 Description of the Proposed Development.

The engineering design of the Proposed Development is underpinned by comprehensive site investigation datasets. The Wind Farm layout optimisation and the design process was iterative, and involved inputs from engineering, hydrogeological, and ecological experts, and through this iterative process areas of poorer ground conditions have been avoided.

Owing to the good geotechnical conditions within the Proposed Development site works can be construction close to the existing surface without the need to strip large volumes of subsoil.

**Table 10.11** provides a summary of proposed turbine foundation designs (i.e., design response at each turbine base (ground bearing foundation, supported on rock)). The depth to bedrock and the composition of subsoils at each turbine, and the foundation type for each turbine are defined based on the comprehensive site investigation data.

Ground bearing foundations will be utilised at all turbines within the Proposed Development site. Ground bearing foundations are suitable at this site due to the coherent and stable nature of the subsoil glacial tills.

Where bedrock is located close to the surface the ground bearing foundation will be within the siltstone / greywacke bedrock.

**Table 10.11: Summary of Proposed Turbine and Substation / BES Foundation Design Proposals**

ID	Foundation Type	Formation Level (mbgl)	Formation Material (based on SI data)	Stone Upfill Depth
T1	Ground-Bearing Gravity	3.0	Rock	0
T2	Ground-Bearing Gravity	3.0	Rock	0
T3	Ground-Bearing Gravity	3.0	Rock	0
T4	Ground-Bearing Gravity	5.0	Clay	0
T5	Ground-Bearing Gravity	5.0	Sand	2.0
Substation and Battery Energy Storage	Ground Bearing Strip, pad or raft foundations	1.80	Clay	0.0

Access roads will be create using cut and fill methods.

The Grid Connection will comprise a single circuit connection with a series of 160mm diameter HDPE power cable ducts and 2 no. 125mm diameter HDPE communication ducts installed in an excavated trench, typically 600mm wide by 1,220mm deep.

HDD works are required at 3nr bridge crossings, 2 no. culverts and below the M1 Motorway along the 12.65km grid connection between the Substation and Drybridge 110kV substation.

substation. The locations of the watercourse crossings are shown on Figure 4-15 of Chapter 4 and in the layout drawings in Appendix 4-1 of this EIAR. Watercourse crossing will be completed using these methods:

#### 10.4.2 Spoil / Material Volumes

During the Proposed Development works spoil will be generated during excavations for roads, hardstands, wind turbine foundations, drainage swales, trenches etc. Minimisation of the production of this spoil will be treated as a high priority, but there will be generation of excess spoil in the form of a mixture of topsoil, rock and glacial till.

It is proposed that a limited amount of spoil material will be stored on-site at a designated spoil repository to the western site of the site track, between turbines T04 and T05, as per the Spoil Management Plan.

A Spoil Management Plan is contained in the **CEMP**. For the construction phase the activities that are considered likely to generate spoil are as follows:

- Construction of new excavated roads;
- Excavation and reinstatement areas for spoil; and,
- Excavations for turbine bases, crane hardstands, substation and the temporary site construction compounds.

Estimated volumes of subsoil and bedrock to be excavated and proposed storage area volumes are shown in **Table 2.9** and **Table 2.10** respectively.

Any bedrock excavated during cut and fill works will be used for filling along the development footprint. Spoil will be reused or stored locally to its point of generation and sufficient storage areas are provided for material that cannot be reused or stored adjacent to turbines and hardstands.

The proposed storage areas can accommodate these volumes without the need to transport any spoil off site.

**10.5 ASSESSMENT OF POTENTIAL EFFECTS**

Where not specifically stated otherwise, all potential effects detailed in this section are pre-mitigation potential effects.

Proposed mitigation measures for each potential effect are listed in Section 10.6 and summaries of both the residual effect following mitigation and its significance are detailed in this section for each of the specific potential effects.

**10.5.1 Do Nothing Effect**

The “Do Nothing Effect” is the effect on the Site should the proposed wind farm not be constructed. In this case, it is envisaged that the current land use would remain as it is now, with continued low intensity grazing for cattle and sheep. Given the nature of the land, being generally pastureland, scrubland, minor forestry and rough grazing, it is unlikely that any substantial changes in this use will occur in the near future.

Other Do Nothing Effects are detailed in **Table 10.12**, below.

**Table 10.12: Do Nothing Effect**

Item	Assessed Element	Assessed Baseline Condition	Anticipated Do Nothing Effect
1	Water Regime – Response to Storm events	Combination of Mobile and Perched groundwater at site of wind farm infrastructure. Because of lack of effective drainage storm events result in a high risk of soil movement.	Do Nothing Potential Effect: <u>Negative, direct, moderate, site-wide / potentially regional, conforms to baseline, likely, short term.</u>
2	Water Regime - Erosion of slopes	Current slopes within the Site are susceptible to soil erosion during high rainfall events.	Do Nothing Potential Effect: <u>Negative, direct, slight, site-wide / potentially regional, conforms to baseline, likely, short term.</u>
3	General Soil Stability	Peat Stability Assessment indicated negligible hazard of peat landslide. Extant soils reside on low gradient slopes at the site of all significant excavations. Blasting occurs regularly on the adjacent quarry lands, so there is potential for impact on wind farm infrastructure during its lifetime.	Do Nothing Potential Effect: <u>Negative, direct, not significant, site-wide, conforms to baseline, unlikely, short term.</u>
4	Land Contamination	Negligible contamination of nature soils and groundwater was encountered at The Site. Potential for activities to cause contamination remains.	Do Nothing Potential Effect: <u>Negative, direct, moderate, site-wide, conforms to baseline, unlikely, long term.</u>

## 10.5.2 Construction Phase Potential Effects

The Proposed Development is characterised by the construction of infrastructure necessary to complete the wind farm as described in **Chapter 2, Description of the Proposed Development**:

The EIA also assesses the Works along the proposed turbine delivery haul route from Galway Port.

The direct and indirect effects of the construction activities, and their expected duration are assessed further in the following sections. The effect on use of land and on natural resources required to carry out the works which relate to soils and geology is also assessed.

The Construction Phase activities that will give rise to effects on soils and geology are listed below: -

- Turbine Construction
- Crane hard stand construction
- Substation, compound and BESS construction
- Temporary compound construction
- Installation of internal cabling
- Installation of grid connection cabling
- Construction of Ste Tracks
- Upgrade Haul Route

These activities will have the following potential effects:

### 10.5.2.1 Land and Land Use

63,272m<sup>3</sup> of subsoil and bedrock removal will occur during construction excavations and is an unavoidable consequence of the Proposed Development. This will result in an adverse affect to land capability for agriculture, causing a loss of moderately productive agricultural lands and a small area of forestry.

Removal of the soil (both organic topsoil and mineral soils) and bedrock is considered to be a permanent effect as it would not normally be reversed, although some reinstatement of the agricultural capability is possible after decommissioning.

**Table 10.13: Effect Summary – Land and Land Use**

Effect Description	Type	Quality	Significance	Extent	Context	Probability	Duration / Frequency
Loss / Change of Land Use	Direct	Negative	Slight	Site	Contrast to baseline	Likely	Permanent

**10.5.2.2 Earthworks Activities**

Subsoil and bedrock removal will occur during construction excavations and is an unavoidable consequence of the Proposed Development. The operation of removing soils and bedrock increases the potential for contaminating soil movements to occur. Processes such as soil instability, poor spoil handling, compaction and subsidence brought about by earthworks activities, can cause a release of silt into the environment, which can adversely affect local sensitive receptors, such as watercourses and their associated flora and fauna.

**10.5.2.2.1 Soil and Bedrock Excavations**

Excavations will be required for most aspects of the Proposed Development including for turbines, turbine hardstand areas, Site access tracks, haul route, Site compound, cable trenches and grid connection route. Estimates of excavation volumes are presented in **Table 2.9**.

The superficial soil material encountered at each turbine and infrastructure location during construction, is considered to be, in the main, a combination of Topsoil and Glacial Till (mineral soils).

Significant bedrock excavations will be required at some of the construction of Turbine Foundations, Turbine Hardstands and Site Access Track excavations. Visual assessment of the bedrock confirms it to be composed of a combination of weak to strong sandstone and greywacke rock types. A portion of this material should also be suitable for re-use after crushing and screening and would be of use as granular fill for Site Access Track construction.

The detailed construction stage ground investigations will confirm the quality and strength of the bedrock, where present. Heavy breakers will be required in areas where deep or large excavations are required in moderately strong to strong rock. Blasting will not be employed to remove rock at the Site.

Site Access Tracks will be needed to accommodate the construction works and to provide access to the turbine locations for the whole life cycle of the wind farm. The tracks will be constructed using unbound crushed aggregates and incorporate drainage to maintain the performance of the pavement during wet weather. This road pavement will be constructed within the firm glacial till soils, following removal of the overlying topsoil, weak organic soils and soft glacial tills.

The potential effects here are considered to be of moderate significance, permanent and negative.

#### 10.5.2.2.2 Haul Route

Haul Routes will generally use the existing public roads. However, some widening will be required at acute turns, within third party lands at the R162 / L-6274-0 Junction. Refer to **Table 2.7, Section 2.6.5.**

Generally, the effects associated with this will be the same as for the Site access track construction but on a very minor scale and reversible. The effects are considered to be **not significant, temporary** and **negative**.

#### 10.5.2.2.3 Site Cable Trenches

Cable trenches throughout the Site will be excavated to a depth of 1.0m. Topsoil and glacial till soils will be stored separately during construction and any excess remaining after reinstatement will be stored permanently on site.

Imported granular fill will be used to surround the cables, however the majority of the excavated soils will be used for backfill with only minor amounts being removed and used elsewhere for berm landscaping. The effects associated with excavations for cable trenches are considered to be **not significant, permanent** and **negative**.

#### 10.5.2.2.4 Grid Connection Cable

Grid connection trenches will also be excavated along the grid connection route to Drybridge 110kV Substation in the townland of Tullyallen. The trenches will be predominantly within roads and verges, to a proposed depth of 1.22m, depending on confirmatory investigations. Excavation of road aggregates, topsoil, topsoil, glacial till and bedrock will be required.

The trenches will be backfilled using imported granular material. The excavated material will be disposed of offsite as inert landfill or recycled for use elsewhere. The effects associated with excavations for cable trenches are considered to be **not significant, permanent and negative**.

#### 10.5.2.2.5 Temporary Construction Compound

Three temporary construction compounds will be employed. The first compound is to the north of Turbine T01. The second is to the north of Turbine T02 and is to be the permanent operations compound. The third is to the south of the 38kV Substation and is another permanent operations compound. Refer to **Section 2.7.8**.

The potential effects here are considered to be **slight, temporary and negative**.

#### 10.5.2.2.6 Storage and Stockpiles / Spoil Management

It is expected that the majority of spoil generated on Site will be either topsoil, small amounts of organic soils, glacial till or rock. This spoil will be re-used, where possible, as fill around infrastructure and to construct stockpiles / bunds along the edge of site tracks, at the substation and around the edges of the construction compound. Surplus spoil will be disposed to permanent spoil storage separated for peat and glacial till / rock materials.

Removal of soil and rock during construction produces spoil that lacks the competence and stability it had before removal. Such spoil represents a hazard to the wider environment where it can be either a potential contaminant, causing siltation of watercourses, or a landslide hazard where earthworks are not managed appropriately.

The handling, management and re-use of excavated spoil material is of importance during the construction phase of the project.

Excavated spoil material will arise from all infrastructure elements of the windfarm (foundations, tracks, hardstands, cabling, grid connection etc.).

Estimated total volumes of material to be excavated are presented in **Section 2.6.14, Table 2.9**.

Within the spoil management process there is potential for a moderate negative 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, as

per NRA Guidelines. A robust sediment and erosion plan, greatly reduces the risk of erosion or sediment release to surface waters.

Organic matter loss can occur when wet peat or organic soils are excavated and allowed to dry in the open air. Such material is a major source of carbon and the loss of organic matter leads to an emission source of carbon dioxide (CO<sub>2</sub>) and nitrogen dioxide (NO<sub>2</sub>). A Carbon Calculator can be found in Chapter 18: Air Quality and Climate, which addresses the effect of loss of carbon to the atmosphere through the drying out of organic soils excavated as part of the Proposed Development.

Excavated soil and bedrock will be re-used for the construction of Site Access Tracks. No excavated soils will be taken offsite.

Any residual soils that cannot be re-used will be stored at a designated spoil repository on lands, adjacent to the access track between T03 and T05. Refer to Management Plan 4 - Spoil Management, contained within the Construction Environmental Management Plan, for further details.

**Section 2.6.14, Table 2.10**, also provides a breakdown for the amount of spoil retained in stockpiles, re-used and permanently stored.

This process of spoil management will have a **moderate, permanent and negative effect** on the geology and soils. Refer to **Table 10.11** for breakdown of the individual effects associated with the spoil management activity.

A general summary of the pre-mitigation effects associated with subsoil and bedrock removal is presented in **Table 10.14**.

**Table 10.14: Effect Summary – Excavation Activities**

Effect Description	Type	Quality	Significance	Extent	Context	Probability	Duration / Frequency
Earthworks Activities – Soil Excavations	Direct	Negative	Moderate	Site	Contrast to baseline	Likely	Permanent
Earthworks Activities - Site Haul Route	Direct	Negative	Not significant	Site	Conforms to baseline	Likely	Temporary
Earthworks Activities – Site Cable Trenches	Direct	Negative	Not significant	Site	Contrast to baseline	Likely	Permanent

Effect Description	Type	Quality	Significance	Extent	Context	Probability	Duration / Frequency
Earthworks Activities – Grid Connection Cable	Direct	Negative	Not significant	Regional	Contrast to baseline	Likely	Permanent
Earthworks Activities – Temporary Construction Compound	Direct	Negative	Slight	Site	Contrast to baseline	Likely	Temporary
Earthworks Activities – Storage and Stockpiles / Spoil Management	Direct	Negative	Moderate	Site	Contrast to baseline	Likely	Permanent

### 10.5.2.3 Vehicular Movement

#### 10.5.2.3.1 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).

This process of vehicle movement will have a **significant, negative and permanent effect** on the geology and soils. Refer to **Table 10.12** for breakdown of the individual effects associated with the vehicle movement.

#### 10.5.2.3.2 Compaction, Erosion and Degradation

Compaction, erosion and degradation of soils will occur during construction. In general, compacted soils will be excavated during the construction process, and access to soils away from hardstanding areas will be prevented. Ongoing compaction of soils will occur in areas of floated road construction, where the effect is considered not to be significant.

Erosion and degradation of exposed soils will also occur during construction where subsoils are stripped of topsoil and exposed to the action of weathering. In general, this will be restricted to the construction footprint for the duration of the construction period only.

These compaction, erosion and degradation effects are also considered to be **significant, permanent and negative**.

#### 10.5.2.3.3 Haul Route and Site Tracks

There will be no material changes to the existing public roads with the exception of temporary widening at one location, the junction of the L162 and L-6274-0, where a new load bearing surface will be laid on third party lands. This will result in compaction of the underlying soils, although this will be slight.

The effects of compaction associated with vehicle movements along the haul route is considered to be **moderate, permanent** and **negative**.

Vehicle movement along the Site Access Tracks will again result in a compaction of the underlying soils. The effects associated with vehicle movements on the geology and soils along the Site Access Tracks is considered to be **moderate, permanent** and **negative**.

A summary of the pre-mitigation effects associated with vehicle movement is given in **Table 10.15**. below

**Table 10.15: Effect Summary – Vehicular Movement**

Effect Description	Type	Quality	Significance	Extent	Context	Probability	Duration / Frequency
Vehicle Movement - Compaction, erosion and degradation of soils arising from vehicular movement	Direct	Negative	Significant	Localised	Contrast to baseline	Likely	Long term / Permanent
Vehicle Movement - Subsidence and settlement of newly established and upgraded Site tracks	Direct	Negative	Moderate	Localised	Contrast to baseline.	Likely	Permanent

**10.5.2.4 Peat Landslide Hazard, Ground Stability and Failure**

Ground instability or failure refers to a significant mass movement of a body of soil or rock that would have an adverse effect on the Proposed Development and the surrounding environment.

Peat Landslide Hazard has been screened out as a potential impact on soils and geology as this was not recorded within the footprint of the windfarm infrastructure.

A significant amount of Site Investigation data has been acquired across the Wind Farm site and this data provides confidence on the depth of topsoil, subsoil and subsoil type. Subsoils are logged as mineral soil glacial till deposits comprising Silty / Clayey SANDS and GRAVELS or Sandy / Gravelly SILTS and CLAYS.

These subsoils are generally not associated with ground instability or a risk of landslides, with overall landslide susceptibility assessed to be low to moderately low within the footprint of the Proposed development.

Site Investigation also confirms the absence of typical karst features, below the subsoils which could impact on ground stability.

An iterative design involving multiple stages of ground investigations, followed by turbine and infrastructure re-design has been completed in order to avoid poor ground conditions. The subsurface conditions underlying the proposed Grid Connection route have also been assessed. Local ground conditions along the route consist of made ground (bituminous macadam surfacing and granular aggregate roadbase) overlying glacial till deposits of varying consistency. No significant areas of peat are recorded or anticipated. Some rock excavation will be required to install the circuits at the scheduled depth.

The potential effects associated with ground stability are contained in table 10.16, overleaf

**Table 10.16: Effect Summary – Peat Landslide Hazard, Ground Stability and Failure**

Effect Description	Type	Quality	Significance	Extent	Context	Probability	Duration / Frequency
Ground Stability and Failure - Stability issues and slope failure arising from vehicular movement (Localised displacement)	Direct or Indirect / Secondary	Negative	Moderate	Localised / Potentially Regional	Contrast to baseline	Likely	Long term / Permanent
Ground Stability and Failure - Stability issues and slope failure arising from vehicular movement (Landslide)	Indirect / Secondary	Negative	Significant	Localised / Potentially Regional	Contrast to baseline	Unlikely	Permanent

#### 10.5.2.5 Soil and Groundwater Contamination

No contaminated soils were recorded during the Site Investigation campaign. Accidental spillage of fuels during construction works is a pollution risk.

The production of waste materials during construction will be minimised by good site practices and adherence to the waste management section of the CEMP. Refer to the Construction Environmental Management Plan (CEMP).

The following sections present a breakdown of all the possible effects associated with the use of construction plant during the construction process.

10.5.2.5.1 Hydrocarbons

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

The accumulation of small amounts of fuels and lubricants during routine plant use can also be a significant pollution risk. Hydrocarbons have a high toxicity to humans, flora and fauna including fish and if released is persistent in the environment. Large spills or leaks have the potential to result in significant effects (i.e. contamination of soil, subsoils and pollution of underlying aquifers) on the geological and water environment.

Any spill of fuel or oil would potentially present a **significant, long-term, negative effect** on the soil and geological environment.

10.5.2.5.2 Wastewater and Sanitation

Wastewater / sewerage from the Temporary Construction Compound will be placed in a holding tank, which will be emptied periodically.

Chemicals will be used to reduce odours. The waste will be taken to a local wastewater sanitation plant for treatment. Wastewater or sewerage leakage may occur but will be small, localised and short-term.

The effects associated with wastewater and sewerage is considered to be **moderate, temporary** and **negative**.

**Table 10.17: Effect Summary – Soil and Groundwater Contamination**

Effect Description	Type	Quality	Significance	Extent	Context	Probability	Duration / Frequency
Soil and Groundwater Contamination - Hydrocarbons	Direct or Indirect / Secondary	Negative	Significant	Localised / Potentially Regional	Contrast to baseline	Likely	Long term / Permanent
Soil and Groundwater Contamination – Wastewater and Sanitation	Direct or Indirect / Secondary	Negative	Moderate	Localised / Potentially Regional	Conforms to baseline	Likely	Temporary

### 10.5.2.6 Quarry Blasting Activity

Blasting currently occurs and is expected to continue throughout the lifetime of The Project, at the adjacent Gallstown Quarry.

This activity can have the potential to affect both the integrity of the works and the safety of the site users / workers. Analysis undertaken by WSP, in respect to Ground Vibration and Air Overpressure Blast Monitoring, indicate that the vibration levels predicted to occur at structures are below the threshold at which we would reasonably anticipate structural damage to occur to the foundations.

During periods of blasting no site users / workers will be permitted within the wind farm and construction works will be suspended at this time.

**Table 10.18** summarises these potential effects.

**Table 10.18: Effect Summary – Quarry Blasting Activity**

Effect Description	Type	Quality	Significance	Extent	Context	Probability	Duration / Frequency
Quarry Blasting – Structural Integrity	Direct	Negative	Slight	Localised	Conforms to baseline	Likely	Long term / Permanent
Quarry Blasting – Site Users Health and Safety	Direct or Indirect / Secondary	Negative	Significant	Localised	Conforms to baseline	Likely	Temporary

### 10.5.2.7 Sites of Geological Heritage

There are a number of geological heritage sites mapped proximal to the Proposed Development. These are located as follows:-

- LH025 Port Raised Beach (4.5 km North East)
- LH025 Oriel Brook (6.5km West)
- LH001 Ardee-Newtown Bedform Field (6.5km North West)
- LH013 Collon Quarry (8.5km South West)
- LH010 Castlebellingham Morainic Complex (8km North)
- LH022 Linns Moraine (9km North)
- LH018 Dundalk Bay (8.5km North)
- LH011 Clogher Head (8.5km East)
- LH012 Clogher Head Wave Cut Platform (8km East)
- LH023 Mell Quarry (6km South)

- LH032 Waterunderbridge - Dry Bridge (6.5km South)
- MH011 Boyne Valley (7.5km South West)

All of these geological heritage sites have been screened out for potential impacts on soils and geology, as they are located too distant from the Proposed Development for any direct or indirect impact on soils and geology to occur.

**Table 10.19: Effect Summary – Sites of Geological Heritage**

Effect Description	Type	Quality	Significance	Extent	Context	Probability	Duration / Frequency
Degradation of Quality of Sites of Geological Heritage caused by emissions / pollution from the Proposed Development	Direct / Indirect	Negative	Imperceptible	Regional	Contrast to baseline	Unlikely	Long term / Permanent

#### 10.5.2.8 Sites of Designated Importance

There are a number of sites of designated importance mapped proximal to the Proposed Development. These are located as follows:-

- Ref 001801 - Barmeath Woods Proposed NHA (3km North)
- Ref 001464 – Mellifont Abbey Woods Proposed NHA (5km West)
- Ref 001293 – Blackhall Woods Proposed NHA (2.5km East)
- Ref 001458 – Castlecoo Hill Proposed NHA (4km East)
- Ref: 001459 –Clogherhead SAC (5km East)
- Ref: 004236 – North West Irish Sea SPA (4.5km East)
- Ref 004080 – Boyne Estuary SPA (6.5km South)
- Ref 001957 – Boyne Coast and Estuary SAC (6.5km South)
- Ref 002299 – River Boyne and River Blackwater SAC (7km South)
- Ref 001804 – King William's Glen Proposed NHA (7km South West)

All of these designated sites have been screened out for potential impacts on soils and geology as they are located too distant from the Proposed Development for any direct or indirect impact on soils and geology to occur.

The following Table details the Pre-Mitigation Potential Effects for Designated Sites.

**Table 10.20: Effect Summary – Sites of Designated Significance**

Effect Description	Type	Quality	Significance	Extent	Context	Probability	Duration / Frequency
Degradation of Quality of Sites of Sites of Designated Importance caused by emissions / pollution from the Proposed Development	Direct / Indirect	Negative	Imperceptible	Regional	Contrast to baseline	Unlikely	Long term / Permanent

**10.5.2.9 Turbine Delivery Route / Haul Route**

- The proposed turbine delivery route is defined in Section 2.6.5. No road widening or junction accommodation works are required along the public road sections of the turbine delivery route, although some areas of oversail are required at 16nr locations. Some minor modifications to street furniture will also be required such as temporary removal of street signs, fencing, traffic lights, street furniture, lighting columns and trimming of hedges.
- Some areas of accommodation are also required within 3<sup>rd</sup> party lands at the junction of the R162 and L-6274-0, which will involve the laying limited excavation and laying down of new roadway, reprofiling of an existing embankment and removal of both a hedge line and wire fence. Telegraph wires and poles will also be temporarily removed for the duration of the construction phase.
- The effects associated with Soils and Geology in respect to the Turbine Delivery Route / Haul Route are given in **Table 10.21**, below.

**Table 10.21: Effect Summary – Turbine Delivery Route**

Effect Description	Type	Quality	Significance	Extent	Context	Probability	Duration / Frequency
Turbine Delivery Route	Direct	Negative	Moderate	Localised / Regional	Conforms to baseline	Likely	Long term / Permanent

**10.5.2.10 Waste Materials**

**10.5.2.10.1 Construction Spoil**

All construction materials will be stored in secure areas. Any hazardous materials will be correctly stored within properly bunded areas in accordance with good Site practice as

described in the IWEA and Scottish Best Practice Guidelines and in accordance with the CEMP.

The effects associated with the use of construction materials are considered to be **moderate, permanent** and **negative**.

10.5.2.10.2 General Waste

All construction and operation waste materials will be correctly sorted, recycled or disposed of practice as described in the IWEA and Scottish Best Practice Guidelines and in accordance with the CEMP. A policy of Reduce, Reuse and Recycle will apply.

The effects associated with waste materials is considered to be **slight, permanent** and **negative**.

In summary, the Proposed Development has the potential to give rise to the following pre-mitigation soil contamination effects, shown in **Table 10.22** below:

**Table 10.22: Effect Summary – Waste Materials**

Effect Description	Type	Quality	Significance	Extent	Context	Probability	Duration / Frequency
Waste Materials – Construction Spoil	Direct	Negative	Moderate	Localised*	Contrast to baseline	Likely	Long term / Permanent
Waste Materials – General Waste	Direct	Negative	Slight	Localised*	Contrast to baseline	Unlikely	Temporary

10.5.3 Health Effects

- Potential health effects arise mainly through the potential for soil, rock and groundwater contamination. The Proposed Development is not a recognised source of pollution and so the potential for effects during the operational phase are negligible.
- Hydrocarbons will be used on site during construction; however, the volumes will be small in the context of the overall scale of The Site and will be handled in accordance with best practice mitigation measures.
- The potential residual impacts to human health associated with soil, hydrocarbon or groundwater contamination are long term, permanent and negative.

#### 10.5.4 Operational Phase Potential Effects

The direct and indirect effects of the operational phase of The Project is assessed in the following sections.

##### 10.5.4.1 Land and Land Use

No further effect on land use is envisaged during the operational phase of the development

##### 10.5.4.2 Earthwork Activities

Subsoils and bedrock removal during the operational phase can be further categorised as Excavations and laying / upgrading of Haul Route and Site Tracks.

###### 10.5.4.2.1 Soil and Bedrock Excavations

No significant new excavations will be undertaken during the operational phase of The Project, although minor works will be undertaken. Any excavation works carried out, during the operational phase, will be limited to that associated with maintenance of the infrastructure and will be both minor and constrained within the original construction footprint.

The effects are considered to be **not significant, temporary and negative**.

###### 10.5.4.2.2 Haul Route

The Site Track network and sections of the haul route will still be employed during the operational phase of The Project. However, this usage will be significantly less than during construction and on an ad hoc basis depending on maintenance or operational requirements.

The effects are considered to be **not significant, permanent and negative**.

###### 10.5.4.2.3 Storage and Stockpile / Spoil Management

Only minor spoil management works associated with ad hoc maintenance will be undertaken during the operational phase of The Project.

These effects are considered to be **not significant, permanent and negative**.

### 10.5.4.3 Vehicular Movement

Only limited vehicle movement will occur during the operational phase of The Project. These vehicles will include cranes, excavators, dumper trucks, concrete trucks, private cars (operational personnel).

As with during construction, compaction of soils will occur during the operational phase, but to a very limited extent. Compaction of soils will continue below the road base, as the sub soils continue to consolidate.

The effects associated with vehicular movement are considered to be **slight, permanent and negative**.

### 10.5.4.4 Peat Landslide Hazard, Ground Stability and Failure

No additional effect on land use is envisaged during the operational phase of the development.

The ongoing potential for ground instability or failure will be **slight, permanent and negative**.

### 10.5.4.5 Soil and Groundwater Contamination

Use of waste materials during the operational phase of The Project will be minimised by established site practices and waste management.

As for the construction phase, wherever there are vehicles and plant in use, there is the potential for a direct hydro-carbon release which may contaminate the soil and subsoil. A spill has the potential to indirectly pollute water, if the soil and subsoil act as a pathway from any source of pollution.

Any spill of fuel or oil would potentially present a **significant, long-term, negative** effect on the soil and geological environment.

During the operational phase wastewater/sewage from the Substation Building Compound will be placed in a holding tank, which will be emptied periodically. Chemicals will be used to reduce odours. The waste will be taken to a local wastewater sanitation plant for treatment. Wastewater or sewerage leakage may occur but will be small, localised and short-term.

The effects associated with wastewater and sewerage is considered to be **slight, temporary and negative**.

#### 10.5.4.6 Blasting Activity at Adjacent Quarry

- Where blasting is to continue at the adjacent quarry this will have an effect on the operation of turbines, access and safety of the site users / workers. During blasting activities at Gallstown Quarry portions of the Wind Farm will be closed for the duration of the blasting activity to prevent injury to site users. Some minor damage could also occur to wind farm infrastructure.
- The effects associated with blasting activity on the operational phase of The Project are considered to be moderate, permanent and negative.

#### 10.5.4.7 Sites of Geological Heritage

No further effect on Geological Heritage is envisaged during the operational phase of the development.

#### 10.5.4.8 Sites of Designated Importance

No further effect on Geological Heritage is envisaged during the operational phase of the development.

### 10.5.5 Waste Materials

#### 10.5.5.1 Operational Waste

All materials required for the operation of the Wind Farm will be stored in secure areas. Any hazardous materials will be correctly stored within properly bunded areas in accordance with good Site practice as described in the IWEA and Scottish Best Practice Guidelines and in accordance with the Standard Operating Procedure. The effects associated with the operational materials is considered to be **slight, permanent and negative**.

##### 10.5.5.1.1 General Waste

All operational waste materials will be correctly sorted, recycled or disposed of practice as described in the IWEA and Scottish Best Practice Guidelines and in accordance with the Standard Operating Procedure. A policy of Reduce, Reuse and Recycle will apply. The effects associated with waste materials is considered to be **slight, permanent and negative**.

The Proposed Development has the potential to give rise to the following effects during the operational phase. Refer to **Table 10.23** below:

**Table 10.23: Effects Summary – Operational Phase**

Effect Description	Type	Quality	Significance	Extent	Context	Probability	Duration / Frequency
Land and Land Use	Direct	Negative	Imperceptible	Localised	Contrast to baseline	Likely	Long term / Permanent
Earthworks Activities	Direct	Negative	Not Significant	Localised*	Contrast to baseline	Likely	Long term / Permanent
Vehicle Movement	Direct	Negative	Slight	Localised*	Contrast to baseline	Unlikely	Long term / Permanent
Peat Landslide Hazard, Ground Stability and Failure	Direct	Negative	Slight	Localised*	Contrast to baseline	Unlikely	Permanent
Soil and Groundwater Contamination	Direct	Negative	Significant	Localised	Contrast to baseline	Likely	Long term / Permanent
Blasting Activity	Direct	Negative	Significant	Localised / Potentially Regional*	Conforms to baseline	Unlikely	Long term / Permanent
Operational Materials	Direct	Negative	Slight	Localised*	Contrast to baseline	Likely	Long term / Permanent
General Waste	Direct	Negative	Slight	Localised	Contrast to baseline	Likely	Permanent

#### 10.5.6 Decommissioning of the Wind Farm

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 the decommissioning period.

Refer to **Table 10.24** for Decommissioning Phase Effects.

**Table 10.24: Effects Summary –Decommissioning Phase**

Effect Description	Type	Quality	Significance	Extent	Context	Probability	Duration / Frequency
Land and Land Use	Direct	Positive	Slight	Localised*	Contrast to baseline	Likely	Long term / Permanent
Earthworks Activities	Direct	Negative	Moderate	Localised*	Contrast to baseline	Likely	Long term / Permanent
Vehicle Movement	Direct	Negative	Moderate	Localised*	Contrast to baseline	Unlikely	Long term / Permanent
Peat Landslide Hazard, Ground Stability and Failure	Direct	Negative	Moderate	Localised*	Contrast to baseline	Unlikely	Permanent
Soil and Groundwater Contamination	Direct	Negative	Significant	Localised	Contrast to baseline	Unlikely	Long term / Permanent
Blasting Activity	Direct	Neutral	Significant	Localised / Potentially Regional*	Conforms to baseline	Unlikely	Long term / Permanent
Turbine Delivery Route	Direct	Negative	Moderate	Localised / Potentially Regional*	Conforms to baseline	Likely	Temporary
Decommissioning Spoil	Direct	Positive	Moderate	Localised*	Contrast to baseline	Likely	Long term / Permanent
General Waste	Direct	Negative	Slight	Localised	Contrast to baseline	Unlikely	Permanent

### 10.5.7 Cumulative Effects

Cumulative effects of the Proposed Development with other developments in the region, as discussed in **Chapter 1: Introduction – Section 1.11.3.2 Cumulative Effects**, relate to the indirect effects that may arise due to the use of public roads as haul routes to bring construction materials to Site and the cumulative effect on the use of natural resources.

The adjacent Gallstown Quarry has been assessed 41 to be a potential cumulative effect to the Proposed Development and these potential effects; Vehicle Movement, Blasting Activity, Turbine Delivery Route / Haul Route are discussed in this chapter.

During the construction of the Project there will be a requirement for the importation of engineered fill from source quarries. A single turbine development 19.5km north of the Proposed Development was granted planning permission in July 2024 (WuXi Biologics: planning ref 2360356). Should construction works of the Proposed Development these coincide with the construction of this single turbine, the demand for imported aggregate for both projects has the potential to have a cumulative impact on local quarries. However, given that the WuXi Biologics project is limited to a single turbine with no permanent buildings and is a distance of almost 20km for the Proposed Development the impact on

locals quarries is expected to be minimal. There are several quarries, stone and concrete suppliers in the surrounding areas of Dundalk. As such, the quantities of aggregate required if both development were constructed within the same period, is considered unlikely to have a significant impact on the quarries.

Should the construction works of the Proposed Development these coincide with demand for imported aggregate for maintenance works at the existing Dunmore Wind Farm (Part 1), Dunmore Wind Farm (Part 2) or Collon Wind Farm, there would a cumulative impact in terms of demands placed on local quarries for aggregate. Given that these wind farms are already constructed and operational it is considered unlikely significant quantities of aggregate would be required by these facilities.

That notwithstanding the construction phase will coincide with increased heavy vehicle traffic on the local public road network.

As such, it is considered there will be a **moderate, negative** and **temporary** cumulative effect, caused mainly by increased vehicle traffic, during the construction and decommissioning phases of the project.

During the operational phase this effect will reduce to a **not significant, negative** and **temporary** cumulative effect.

## 10.6 MITIGATION MEASURES AND RESIDUAL EFFECTS

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

### 10.6.1 Design Phase

With regard to the proposed project, design and best practice has been and will be implemented as follows:

The primary mitigation measure employed has been the design of the wind farm in terms of locating the turbines, access roads, material storage areas and other site infrastructure on agricultural lands and minor forestry, where the soils are extensively worked and drained, so as to be remote from residential and sensitive commercial properties.

In order to reduce the impacts on geology, hydrogeology and slope stability, infrastructure has also been positioned within areas of thinner organic soils / soft ground and lower slope gradients away from designated watercourses and other sensitive features. Extensive work

has already been undertaken at the preliminary design stage to apply risk avoidance by design which has included:

- Extensive peat probing to screen for the presence of peat or other organic soil deposits across the site and layout takes this into account for the purpose of placement of wind farm infrastructure. No significant wind farm infrastructure will be constructed within 100m of peat bog of thickness greater than 0.50m.
- Excavation of trial pit and advancement of boreholes to establish overburden and bedrock characteristics.
- Relocation and micro-siting of turbines, hardstandings, access roads and other infrastructure based on the site assessments and geotechnical assessments in order to reduce ground risk associated with the proposed project.
- The works have been designed and checked by geotechnical engineers, who are suitably qualified and experienced in excavation and earthworks design and construction methodologies.

The following will also be implemented:

- Any excavation and construction related works will be subject to a design risk assessment at detailed design stage to determine risk levels for the construction, operation and maintenance and decommissioning of the works. Identified impacts will be minimised by the application of principles of avoidance, prevention and protection. Information on residual impacts will be recorded and relayed to appropriate parties
- A detailed method statement for each element of the works will be prepared by the Contractor prior to any element of the work being carried out.
- Given that the works comprise a significant proportion of excavation and earthworks, suitably qualified and experienced geotechnical personnel will be required on site to supervise the works.
- The Contract will require programming of the works such that earthworks are not scheduled during severe weather conditions.

## 10.6.2 Construction Phase

The following sections outline appropriate mitigation measures to avoid or reduce the potential effect of the Proposed development during the construction phase.

### 10.6.2.1 Construction Environmental Management Plan

A Construction Environmental Management Plan (CEMP) has been prepared for the proposed project and is included in **Volume IV, Appendix 2.1**. The CEMP defines the work

practices, environmental management procedures and management responsibilities relating to the construction phase of the proposed project.

The CEMP sets out the key environmental management measures associated with the construction, operation and decommissioning of the proposed wind farm, to ensure that during these phases of the development, the environment is protected, and any potential impacts are minimised.

The final CEMP will be developed further at the construction stage, on the appointment of the main contractor to the project to address the requirements of any relevant planning conditions, including any additional mitigation measures that are conditioned and shall be submitted to the planning authority.

Reference to relevant sections of the CEMP with respect to the mitigation of potential effects to Soils and Geology from the proposed project are outlined in the following sections.

#### **10.6.2.2 Land and Land Use**

No further mitigation is proposed.

#### **10.6.2.3 Earthworks Activities**

Implementation of the proposed development will result in the removal of soils in parts of the site to facilitate excavation for the construction of access roads and platforms for the wind turbines to a competent stratum or bedrock suitable for the emplacement of foundations.

Ground conditions vary across the site with varying depths of soil cover. At the proposed turbine bases, excavation required is anticipated to be up to 5.00m to a suitable bearing stratum as trial holes excavated to 3.70m depth below existing ground level did not record soils and / or rock suitable for emplacement of turbine foundations.

The project will be constructed in a phased manner in order to reduce the potential effects of The Project on the Soils and Geology. Phased construction reduces the amount of open, exposed excavations at any one time.

Given that the works comprises a significant proportion of excavation and earthworks, suitably qualified and experienced geotechnical personnel will be deployed on site to supervise the works.

Details of the proposed methodology and mitigation measures are summarised below and are also outlined in **Sections 3.3.1** and **3.3.2** of the CEMP in **Appendix 2.1** of **Volume IV**.

One of the primary mitigation measures employed at the preliminary design stage was the minimisation of volumes of excavated overburden deposits to be exported off site. All excavated overburden will be retained on-site.

This will include:

- Use of suitable site won material (bedrock) as general fill in the construction of access tracks, hardstands and in reinstatement around turbine foundations.
- Surplus overburden will be re-used on site in the form of landscaping and for reinstatement purposes at the existing on-site borrow pit.
- Residual surplus overburden will also be stored at a permanent spoil repository, located to the west of the site track between Turbines T4 and T5. Refer to **the Spoil Management Plan** (CEMP) for details.

Surplus overburden deposits excavated during the course of the works will be temporarily stored in designated areas adjacent to the construction phase excavations prior to reuse. Some temporary stockpiles (not exceeding 2m in height) of material will be necessary adjacent to the excavation areas prior to reinstatement. No surplus/waste soil or rock will be removed from the proposed project site.

Temporary stockpiles will be shaped and sealed to prevent the ingress of water from rainfall.

To mitigate against the compaction of soil at the site, prior to the commencement of any earthworks, the work corridor will be demarcated, and machinery will stay within this corridor so that soils outside the work area are not damaged.

Excavations will then be carried out from access tracks as they are constructed in order to reduce the compaction of soft or otherwise sensitive ground.

#### **10.6.2.4 Vehicular Movements**

Vehicular movements will be restricted to the footprint of the Proposed Development, particularly with respect to the newly constructed Site Access Tracks. This ensures that machinery must be kept on tracks and will not move onto areas that are not permitted.

Vehicular traffic on Site will be minimised through the re-use of excavated material on Site which will reduce the need to source material from external quarries.

As discussed previously, excavation volumes have been reduced during the design phase by avoiding areas of sensitive or soft soils and by avoiding excessive cut and fill during construction. This will result in reduced excavation volumes and therefore reduced Site traffic.

Best practice as described in the IWEA and Scottish Best Practice Guidelines will be applied during construction which will minimise double handling, again reducing the Site traffic.

All works will be managed and carried out in accordance with the Construction Environmental Management Plan (**Sections 3.3.3** of the CEMP in **Appendix 2.1** of **Volume IV**), which will be updated by the civil engineering contractor and agreed prior to any Site works commencing.

#### 10.6.2.5 Soil Contamination

Careful design of the wind farm has reduced the amount of Site traffic required on Site by reducing access tracks lengths, excavation volumes and double handling. Similarly, good Site practice and a robust CEMP (**Technical Appendix 2.1**) will also result in less traffic and a lower potential for fuel spills and leakages.

The CEMP (**Sections 3.3.5** and **3.4.4** of the CEMP in **Appendix 2.1** of **Volume IV**) requires the checking of assets (plant, vehicles, fuel bowsers) on a regular basis during the construction phase of the Proposed Development. 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.

Fuel management procedures adopted will include 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.

The emergency response plan, as detailed in the CEMP, has been developed in order to deal with any emergency accidents or spills. In particular an emergency spill kit with oil boom and absorbers will be kept on Site in the event of an accidental spill. All Site operatives will be trained in its use. In addition, all vehicles will also contain emergency spill kits.

#### 10.6.2.6 Ground Stability and Failure

As discussed previously, careful design of the wind farm has reduced the amount of construction required in areas of sensitive or soft soils, high slopes and other areas of potential ground instability.

With regard to slope stability issues, detailed design and construction phase best practice will be implemented as follows:

- The works will be supervised by a suitably qualified and experienced geotechnical engineer or engineering geologist, and hydrologist or drainage engineer.
- Drainage infrastructure will be put in place in advance of excavations. Drains will divert surface water and groundwater away from excavations into the existing and proposed surface drainage network. Uncontrolled, direct and concentrated discharges of water onto the ground surface will be avoided.
- Loading or stockpiling of materials on the surface of soft ground will be avoided. Loading or stockpiling on other deposits will not be undertaken without first establishing the adequacy of the ground to support loads by an appropriately qualified geotechnical engineer experienced in construction within upland conditions. No stockpiling of material shall take place on slopes greater than 5 degrees to the horizontal. The height of temporary stockpiles will not exceed 2m.
- Turbines located in areas adjacent to peat deposits will incorporate drainage measures such that surface water will be drained away from the peat and will not be allowed to collect adjacent to the peat mass.
- Excavation will be carried out from access roads or hardstanding areas to avoid tracking of construction plant across areas of soft ground/peat.
- An assessment of the stability at proposed infrastructure locations has been carried out as part of this EIAR based on worst case conditions. A further assessment will be undertaken at detailed design stage.
- Blasting of rock will not be permitted.

- Excavations which could have the potential to undermine the up-slope component of an existing slope will be sufficiently supported to resist lateral slippage and careful attention will be given to the existing drainage.
- Earthworks will not be commenced when heavy or sustained rainfall is forecast. A rainfall gauge will be installed on site to provide a record of rainfall intensity. An inspection of site stability and drainage by the Geotechnical Engineer will be carried out on site when a daily rainfall of over 25mm is recorded on site, works will only recommence after heavy rain with the prior approval of the Geotechnical Engineer following inspection.

The Construction Environmental Management Plan (**Section 3.3.4** of the CEMP in **Appendix 2.1** of **Volume IV**) includes an emergency response to be applied in the unexpected event of a landslide or ground instability. In particular, catch fences and other physical barriers (i.e. concrete blocks) will be on Site and available in sufficient quantities to be used in the event of ground instability.

#### **10.6.2.7 Blasting Activity at Gallstown Quarry**

Where blasting is to continue at the adjacent quarry this can have the potential affect both the integrity of the works and safety of the site users / workers.

During blasting activities at Gallstown Quarry portions of the Wind Farm will be closed for the duration of the blasting activity to prevent injury to site users.

At these times the following mitigation measures will be enacted:-

The construction works programme will be co-ordinated with that of the Gallstown Quarry blasting programme.

A 500m radius exclusion zone centred on the blast site will be delineated on site with lockable gates installed at entry / exit points.

Signage will be erected to warn site users of the blasting hazard and the need to keep out of the exclusion zone. Signage will also detail the annual calendar of these expected events.

### 10.6.2.8 Material and Waste Management

All materials used on Site and wastes generated on Site will be reduced by good Site practice and attention to the CEMP (**Sections 3.3.7 and 3.4.4** of the CEMP in **Appendix 2.1 of Volume IV**). 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 to landfill.

Whenever possible, excavated spoil materials will be re-used close to the area of excavation. The careful design which has been achieved will result in minimal excess soil and rock.

### 10.6.2.9 Construction Phase Residual Effects

The residual effects after implementation of all mitigation measures for the construction phase of the Proposed Development are presented in **Table 10.25**.

**Table 10.25: Construction Phase Residual Effect Summary**

Effect Description	Type	Quality	Significance	Extent	Context	Probability	Duration / Frequency
Loss / Change of Land Use	Direct	Negative	Slight	Site	Contrast to baseline	Likely	Permanent
Earthworks Activities – Soil Excavations	Direct	Negative	Slight	Site	Contrast to baseline	Likely	Permanent
Earthworks Activities - Site Haul Route	Direct	Negative	Not significant	Site	Contrast to baseline	Likely	Temporary
Earthworks Activities – Site Cable Trenches	Direct	Negative	Not significant	Site	Contrast to baseline	Likely	Permanent
Earthworks Activities – Grid Connection Cable	Direct	Negative	Not significant	Regional	Contrast to baseline	Likely	Permanent
Earthworks Activities – Temporary Construction Compound	Direct	Negative	Slight	Site	Contrast to baseline	Likely	Temporary
Earthworks Activities – Storage and Stockpiles / Spoil Management	Direct	Negative	Slight	Site	Contrast to baseline	Likely	Permanent
Vehicle Movement - Compaction, erosion and degradation of soils arising from vehicular movement	Direct	Negative	Slight	Localised	Contrast to baseline	Likely	Long term / Permanent
Vehicle Movement - Subsidence and settlement of newly established and upgraded Site tracks	Direct	Negative	Slight	Localised	Contrast to baseline.	Likely	Permanent
Ground Stability and Failure - Stability issues and slope failure arising from vehicular movement (Localised displacement)	Direct or Indirect / Secondary	Negative	Slight	Localised / Potentially Regional	Contrast to baseline	Likely	Long term / Permanent

Effect Description	Type	Quality	Significance	Extent	Context	Probability	Duration / Frequency
Ground Stability and Failure - Stability issues and slope failure arising from vehicular movement (Landslide)	Indirect / Secondary	Negative	Slight	Localised / Potentially Regional	Contrast to baseline	Unlikely	Permanent
Soil and Groundwater Contamination - Hydrocarbons	Direct or Indirect / Secondary	Negative	Slight	Localised / Potentially Regional	Contrast to baseline	Unlikely	Long term / Permanent
Soil and Groundwater Contamination – Wastewater and Sanitation	Direct or Indirect / Secondary	Negative	Slight	Localised / Potentially Regional	Contrast to baseline	Unlikely	Long term / Permanent
Quarry Blasting – Structural Integrity	Direct	Negative	Slight	Localised	Conforms to baseline	Likely	Long term / Permanent
Quarry Blasting – Site Users Health and Safety	Direct or Indirect / Secondary	Negative	Moderate	Localised	Conforms to baseline	Likely	Temporary
Degradation of Quality of Sites of Geological Heritage caused by emissions / pollution from the Proposed Development	Direct / Indirect	Negative	Imperceptible	Regional	Contrast to baseline	Unlikely	Long term / Permanent
Degradation of Quality of Sites of Sites of Designated Importance caused by emissions / pollution from the Proposed Development	Direct / Indirect	Negative	Imperceptible	Regional	Contrast to baseline	Unlikely	Long term / Permanent
Turbine Delivery Route	Direct	Negative	Not significant	Localised / Regional	Conforms to baseline	Likely	Long term / Permanent
Waste Materials – Construction Spoil	Direct	Negative	Slight	Localised*	Contrast to baseline	Likely	Long term / Permanent
Waste Materials – General Waste	Direct	Negative	Slight	Localised	Contrast to baseline	Unlikely	Temporary

### 10.6.3 Operational Phase

It is not envisaged that the operation of The Project will result in significant impacts on the Soils and Geology regime within the study area, as there will be no further disturbance of overburden postconstruction.

The main potential residual impact during the operation phase would be the risk to groundwater from contamination from spills. Storage tanks, used to store fuel for the various items of machinery, will be self-contained and double-walled. Refuelling of maintenance vehicles will be carried out from these tanks or from delivery vehicles at designated refuelling areas. Specific mitigation measures relating to the management of hydrocarbons are as follows:

- Fuels, lubricants and hydraulic fluids for equipment used on the site will be carefully handled to avoid spillage.
- Any spillage of fuels, lubricants or hydraulic oils will be immediately contained, and the contaminated soil removed from the site and properly disposed of;

- Waste oils and hydraulic fluids will be collected in leak-proof containers and removed from the site for recycling and
- Appropriate spill control equipment, such as oil soakage pads, will be kept within the refuelling areas and in each item of plant to deal with any accidental spillage.

All wastes from the substation, battery storage and ancillary facilities will be removed by the appropriate contractor. The operational team will carry out maintenance works (to Site Access Tracks, Substation, Battery Energy Storage 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.

Due to the reduced magnitude of the effects, no additional mitigation measures are required for the maintenance and operation of the wind farm, over and above those incorporated into the design of the substation transformers and batteries, which will be bunded to protect soils against accidental leakages of oils and battery fluids.

These potential effects are limited by the size of the fuel tank of vehicles used on the Site. Additional potential effects will occur in the event that a turbine needs replacement. The effects associated with this will be similar to those involved for vehicles movements during construction but much reduced.

Blasting Activity at adjacent Quarry will continue throughout the operational phase of the wind farm. During these periods the operational works programme for the wind farm will be co-ordinated with that employed at the quarry for quarry blasting and the relevant mitigation employed to avoid risk to site users.

There are no other effects relating to soils and geology during the operational phase of the Proposed Development.

#### 10.6.3.1 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 as described in the IWEA and Scottish Best Practice Guidelines as detailed in the CEMP (**Sections 3.3 and 3.4** of the CEMP in **Appendix 2.1 of Volume IV**); 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 **not significant, permanent, negative** effect on the Site.

The residual effects after implementation of all mitigation measures for the operational phase of the Proposed Development are presented in **Table 10.26**.

**Table 10.26: Operational Phase Residual Effect Summary**

Effect Description	Type	Quality	Significance	Extent	Context	Probability	Duration / Frequency
Land and Land Use	Direct	Negative	Not Significant	Localised*	Contrast to baseline	Likely	Long term / Permanent
Earthworks Activities	Direct	Negative	Not Significant	Localised*	Contrast to baseline	Likely	Long term / Permanent
Vehicle Movement	Direct	Negative	Slight	Localised*	Contrast to baseline	Unlikely	Long term / Permanent
Ground Stability and Failure	Direct	Negative	Slight	Localised*	Contrast to baseline	Unlikely	Permanent
Soil and Groundwater Contamination	Direct	Negative	Slight	Localised	Contrast to baseline	Likely	Long term / Permanent
Blasting Activity	Direct	Negative	Moderate	Localised / Potentially Regional*	Conforms to baseline	Unlikely	Long term / Permanent
Turbine Delivery Route	Direct	Negative	Slight	Localised / Potentially Regional*	Conforms to baseline	Likely	Long Term
Operational Materials	Direct	Negative	Not significant	Localised*	Contrast to baseline	Likely	Long term / Permanent
General Waste	Direct	Negative	Not significant	Localised	Contrast to baseline	Likely	Permanent

#### 10.6.4 Decommissioning and Restoration Phases

Following the permitted lifespan of the wind farm, decommissioning of the infrastructure will occur or the Site may be repowered with more modern turbines, subject to a separate planning application.

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

Some of the effects associated with reinstatement of the site (excavation of access tracks) will be avoided by leaving these in place where possible.

It is proposed to leave the access tracks in-situ at the decommissioning stage. IWEA state that "it may be best" to leave site tracks in-situ depending on the size and geography of the development.

It is considered that leaving the access tracks in-situ will cause less environmental damage than removing and recycling them, so these elements of the construction will be retained.

Turbine base, hardstand and other ancillary infrastructure will be removed and covered with overburden material to allow for re-vegetation of the development site.

Areas of excess soil and rock will be reused in order to match the surrounding land as near as possible. Drainage and slopes will be restored as close to the original ground as possible.

Grid connection infrastructure including substations and ancillary electrical equipment shall form part of the national grid and will be left in situ. Removal of this infrastructure would result in considerable disruption to the local environment in terms of increased sedimentation, erosion, dust, noise, traffic and an increased possibility of contamination of the local water table.

However, if removal is deemed to be required by the respective local authority all infrastructure will be removed with mitigation measures similar to those during construction being employed.

Mitigation measures to avoid contamination by accidental fuel leakage and compaction of soil by on-site plant will be implemented as per the construction phase mitigation measures outlined above.

#### **10.6.4.1 Decommissioning Phase Residual Effects**

The residual effects associated with decommissioning includes waste generation, hydrocarbon leakage and erosion of soil and rock. In general, effects will be similar to those at construction, but of a greatly reduced magnitude.

On completion of reinstatement works, it is expected that the wind farm will be returned as close to its present condition as possible. In particular, areas where local drainage has been altered will be reinstated.

Refer to **Table 10.27** for Decommissioning Phase Residual Effects.

**Table 10.27: Decommissioning Phase Residual Effect Summary**

Effect Description	Type	Quality	Significance	Extent	Context	Probability	Duration / Frequency
Land and Land Use	Direct	Positive	Slight	Localised*	Contrast to baseline	Likely	Long term / Permanent
Earthworks Activities	Direct	Neutral	Slight	Localised*	Contrast to baseline	Likely	Long term / Permanent
Vehicle Movement	Direct	Negative	Slight	Localised*	Contrast to baseline	Unlikely	Long term / Permanent
Peat Landslide Hazard, Ground Stability and Failure	Direct	Negative	Slight	Localised*	Contrast to baseline	Unlikely	Permanent
Soil and Groundwater Contamination	Direct	Negative	Slight	Localised	Contrast to baseline	Likely	Long term / Permanent
Blasting Activity	Direct	Neutral	Moderate	Localised / Potentially Regional*	Conforms to baseline	Unlikely	Long term / Permanent
Turbine Delivery Route	Direct	Negative	Slight	Localised / Potentially Regional*	Conforms to baseline	Likely	Temporary
Decommissioning Spoil	Direct	Positive	Slight	Localised*	Contrast to baseline	Likely	Long term / Permanent
General Waste	Direct	Positive	Slight	Localised	Contrast to baseline	Likely	Permanent

## 10.7 SUMMARY OF SIGNIFICANT EFFECTS

Providing the mitigation measures outlined in this chapter are fully implemented and best practice as described in the IWEA and Scottish Best Practice Guidelines is followed on Site, it is expected that effects associated with the Proposed Development will not be significant.

The CEMP (**Appendix 2.1**) also includes a suitable monitoring programme which will ensure that there is rigid adherence both to the CEMP and to the mitigation measures outlined here during construction, operation and decommissioning of the wind farm.

## 10.8 REFERENCES

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