8. LAND, SOILS & GEOLOGY

8.1 INTRODUCTION

This chapter of the EIAR assesses the effects of the proposed project on the land, soil and geological environment. A full description of the proposed project is detailed in Chapter 2 (Description of the Proposed Project). Details of the existing conditions of the proposed project site are presented, potential impacts are assessed, and mitigation measures are proposed where required. Residual and cumulative effects are also assessed.

8.1.1 Statement of Authority

TOBIN Consulting Engineers have completed this chapter with geotechnical input from Ciaran Reilly & Associates. TOBIN Hydrologists and Hydrogeologists are intimately familiar with the characteristics for the proposed project, having worked on wind farms at Lisheen III, Castlebanny, Derryadd and Bruckana.

This chapter has been completed by Mr. John Dillon (BSc, MSc, MCIWM, PGeo), TOBIN Consulting Engineers. John has 18 years of experience in geological assessment for EIS/EIA. John also has experience in the assessment and supervision of renewable energy projects including Curragh wind farm, Castlebanny windfarm, Lisheen Phase III wind farm, Derryadd wind farm, Ummeras wind farm, Cloon – Lanesboro 110kv uprate, North South 400kV interconnector, Moneypoint substation, Clonymeath Solar Farm and Laois Kilkenny 400/110 kV substation.

Ciaran Reilly is a chartered geotechnical engineer, holding a PhD in geotechnical engineering from Trinity College Dublin and a BE in civil, structural & environmental engineering from National University of Ireland, Galway. He has strong specialist experience in geotechnical design and a wide range of experience in general civil engineering design and construction management, having worked with consultants, contractors, and clients in the design, checking, construction and project management of a range of geotechnical and civil engineering projects. Ciaran's project experience includes site investigation, landfill remediation, bridges, water and wastewater treatment schemes, flood relief schemes, road, rail, and cycleway/greenway infrastructure, reinforced soil, structural repair, offshore structures, and wind farms.

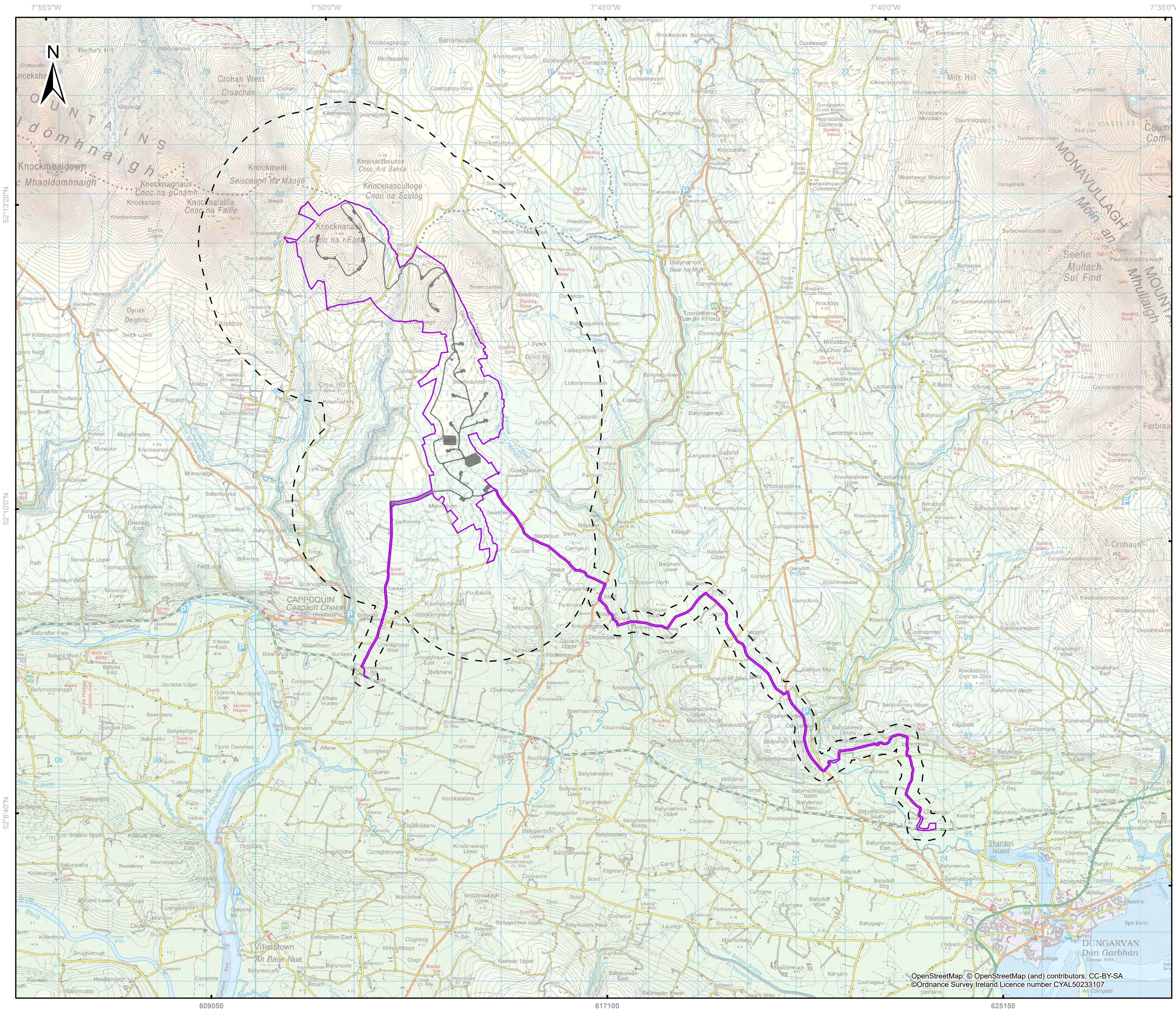
Joe Greene (BSc, MSc) is a geologist with ten years of experience in the environmental sector in Ireland and the UK. Joe has been involved in EIARs for grid connections, waste and quarry developments. Michelle Gaffney (BSc) is a geologist with four years of experience in the environmental sector in Ireland. Michelle has been involved in EIARs for wind farms and grid connection developments. Both Joe and Michelle provided input to this chapter.

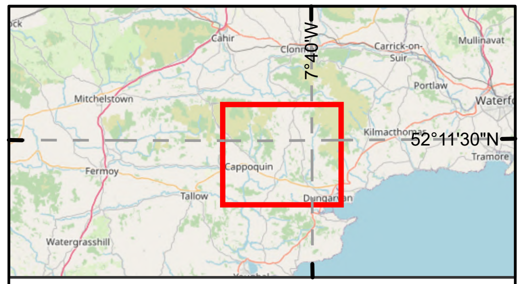
8.2 ASSESMENT METHODOLOGY

The baseline environment of the proposed wind farm site and its auxiliary areas (including the proposed grid connection route (GCR) and works areas of the proposed turbine delivery route (TDR)) was thoroughly investigated through extensive desk studies and field inspections. The methodology for this chapter involved a combination of desk research, site walkovers and intrusive investigations, such as trial pits, boreholes, gouge augers and peat probes.

The study area for the Land, Soils and Geology assessment is outlined in Figure 8-1, and has been defined on the basis of a 2 km radius from the proposed wind farm site, as suggested in the

Institute of Geologists (IGI) 'Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements' (IGI 2013). The study area for the works area of the proposed TDR and proposed GCR uses a 200m buffer, based on the limited works and excavations and best practice.





Legend

- Proposed project
- Proposed infrastructure footprint within the proposed wind farm site
- Study area

0 | 1.5 | 3
Kilometers

NOTES

1. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING\
2. ALL DRAWINGS TO BE CHECKED BY THE CONTRACTOR ON SITE\
3. ENGINEER TO BE INFORMED OF ANY DISCREPANCIES BEFORE ANY \ WORK COMMENCES\
4. ALL LEVELS RELATE TO ORDNANCE SURVEY DATUM AT MALIN HEAD

Rev	Date	Description	By	Chkd.
A	12/12/2024	First issue	S.P	J.S

Client: FuturEnergy Ireland

Project: Scart Mountain Wind Farm

Title: Figure 8-1 Study area

Scale @ A3: 1:70,000

Prepared by:	Checked by:	Date:
S.Pezzetta	J.Staunton	December 2024

TOBIN

Tel: +353-(0)1-8030406
Email: info@tobin.ie
www.tobin.ie

Map Ref: 11303-041-SO.GEO..StA-S.BO-TOB-A

Draft: A

8.2.1 Guidance and Legislative Review

Geological specific guidance published by the Institute of Geologists of Ireland (IGI) and Transport Infrastructure Ireland was used when preparing this chapter. The nomenclature set out in the EPA 2022 guidance was used to assign magnitude of significance. The chapter was prepared having regard to the following guidelines:

- Guidelines on the Information to be contained in Environmental Impact Assessment Reports (EPA, 2022);
- European Communities (Water Policy) Regulations 2003 [S.I. No. 722/2003];
- Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (NRA 2008b);
- Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements (IGI 2013);
- Peat Landslide Hazard and Risk Assessments, Best Practice Guide for Proposed Electricity Generation Developments - Second Edition (Natural Scotland Scottish Executive, 2017);
- Department of the Environment, Heritage and Local Government (DoEHLG), Wind Energy Development Guidelines (2006);
- Review of Wind Energy Development Guidelines "Preferred Draft Approach" (Department of Housing, Planning, Community and Local Government, 2019); and
- Scottish Natural Heritage (2013) Research and Guidance on Restoration and Decommissioning of Onshore Wind Farms Commissioned Report No. 591/ SNH, Stirling.

This impact assessment of the proposed project has been carried out in compliance with the relevant European and National legislation and other statutory policies and guidance. The methodology adopted for this assessment takes account of the following legislation:

- Planning and Development Act 2000 as amended;
- European Union (2000/60/EC) Water Framework Directive
- European Union (1992/43/EEC) Habitats Directive
- Waste Management Act 1996 as amended;
- European Communities Environmental Objectives (Groundwater) Regulations 2010 [S.I. No. 9/2010];
- Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment Text with EEA relevance; and
- Groundwater Directives (2006/118/EC).

8.2.2 Desk Review

A desk study of the study area (the boundary as shown in Figure 8-1 of this EIAR) was undertaken to collate and review background information of the receiving environment. The sources of information obtained are listed below:

- Examination of the Geological Survey of Ireland (GSI) datasets pertaining to geological and extractive industry data; (accessed on 24th April 2024)
- Examination of Environmental Protection Agency (EPA) soil and subsoils datasets; (accessed on 24th April 2024)

- Examination of National Parks and Wildlife Service (NPWS) nature conservation designations; (accessed on 24th April 2024)
- Preparation of site maps and suitable field sheets for the site survey.

Information on the topography and geomorphology of the area has been obtained from publicly available data on the GeoHive, GSI and EPA websites as well as Site Lidar data.

Desk study information is detailed in Section 8.4.1.

8.2.3 Field Surveys

A total of seven walkovers were undertaken of the proposed wind farm and auxiliary areas to review the ground conditions and assess the topography and geomorphology. These were carried out in May 2022, September 2022, November 2022, June 2023, July 2023, August 2023 and November 2023.

Field surveys by TOBIN and Ciaran Reilly Associates, were undertaken in November 2022, August 2023 and November 2023 to assess ground conditions and monitor site investigations.

A ground investigation (GI) was carried out from October 2023 to January 2024 to determine the subsurface conditions at the proposed wind farm site and on the proposed GCR crossing of the River Colligan. All works were completed using Ground Investigation Ireland (GII) plant and logging was completed by a GII engineering geologist.

The scope of the work undertaken included the following:

- Site visit to observe existing conditions;
- Carry out 24 No. Trial Pits to a maximum depth of 3.1 metres below ground level (m bgl);
- Carry out 9 No. Gouge Augers to collect peat samples for testing;
- Carry out 6 No. Rotary Core Boreholes to a maximum depth of 23m bgl;
- Installation of 5 No. Groundwater monitoring wells;
- Peat Probing;
- Geotechnical & Environmental Laboratory testing;
- Development of a Factual report.

The trial pits were excavated using a JCB 3CX excavator at the locations shown in Figure 8-7. Shear vane tests were carried out at the locations and the results of the tests are included in Appendix 2-9. The Shear vane tests were carried out using a Geonor H60 handvane at a depth of 1.0m bgl.

Where excavator access to the turbine location was not possible (due to trees), the trial pit was excavated at the nearest accessible location with peat probes and gouge augers were undertaken at the turbine locations to check for the presence of peat. Gouge Augers are manually operated stainless-steel corkscrew-shaped filling type samplers. Trial pits and gouge augers, as shown in Figure 8-7, were undertaken at the accessible locations that were representative of the proposed infrastructure, including the turbines, roads, construction compounds, borrow pits and the substation.

The rotary coring of boreholes was carried out by a track mounted T41 Beretta rig at the locations shown on Figure 8-7. The exploratory hole locations have been recorded using a KQ GEO Technologies KQ-M8 System which records the coordinates and elevation of the locations to ITM.

Regular sampling and in-situ testing was undertaken in the exploratory holes to facilitate the geotechnical descriptions and to enable laboratory testing to be carried out on the soil samples recovered during excavation and drilling. The procedures used in this site investigation are in accordance with Eurocode 7 Part 2: Ground Investigation and testing (ISEN 1997 – 2:2007) and B.S. 5930:2015.

Results of the Field study are detailed in section 8.4.2.

8.2.4 Consultation

The EIA Scoping and consultation activities were carried out as set out in Section 1.8 of this EIAR. The purpose of EIA scoping is to provide a framework for the approach to be taken by the individual specialists in carrying out their evaluations, identifying environmental aspects for which potential significant environmental effects may arise.

The response to consultation specific to Land, Soils and Geology is outlined in Table 8-1 with full responses included in Appendix 1-4 of the EIAR.

Table 8-1: Response to Consultation specific to Land Soils and Geology

Department	Comments and Recommendations	EIAR Chapter/Section
Geological Survey Ireland	• Letter encouraging the use of their datasets. Confirmation that there are no County Geological Sites near the proposed project. Also provided information on groundwater, geological mapping, geotechnical database resources, geohazards (noting the presence of moderately high and high landslide susceptibility in the area of the proposed Wind Farm), natural resources, geochemistry (of soils, surface waters and sediments). They also requested that a copy of any reports detailing site investigations be sent to them to add to their data.	• Ch15 Cultural Heritage • Ch8 Land, Soils & Geology • Ch9 Hydrogeology and Hydrology
Inland Fisheries Ireland	• Response provided information on ground stability, physical interference with stream channels, prevention of discharges of polluting matters such as cement, prevention of silt deposition in streams, storage of fuels/oils etc., stream crossings. Response highlighted that the crossing of watercourses at fords is unacceptable and culvert pipes are not recommended, and that increased volumes of surface water runoff from hardcore areas must not impact river habitats by giving rise to erosion.	• Ch6 Biodiversity • Ch8 Land, Soils & Geology • Ch9 Hydrogeology and Hydrology
• Uisce Éireann	Uisce Éireann does not have scope to provide specific guidance on individual projects, but it outlines key considerations for Water Services within the scope of an Environmental Impact Assessment (EIA). For developments with potential impacts on Uisce Éireann's Drinking Water Sources,	• Ch8 Land, Soils & Geology • Ch9 Hydrogeology and Hydrology •

Department	Comments and Recommendations	EIAR Chapter/Section
	applicants must detail measures to prevent negative effects during construction and operation, identifying hydrological pathways between the applicant's site and receiving waters. Other requirements include waste sampling strategies for backfilled materials, mitigations for potential negative impacts on nearby water sources, assessments of impacts on public water supply reservoirs, and confirmation of water service capacity through a Confirmation of Feasibility (COF). Developers seeking connections to a public water supply or sewage collection system are advised to submit a Pre-Connection Enquiry (PCE). Additionally, the proposal should identify necessary upgrades to water services infrastructure, address trade effluent discharge considerations, and assess the management of surface water, including potential impacts on combined sewer networks. Physical impacts on Uisce Éireann assets must also be identified, encompassing reservoirs, drinking water sources, treatment works, pipes, pumping stations, and discharge outfalls, including any required asset relocations.	

8.2.5 Impact Assessment Methodology

The approach to impact assessment proposed in the IGI guidelines (2013) and EPA (2022) is adopted for the evaluation of potential effects on the receiving environment.

The study area for the Land, Soils and Geology assessment is outlined in Figure 8-1, and has been defined on the basis of a 2 km radius from the proposed wind farm site, as suggested in the IGI 2013 Guidelines. The study area for the works areas of the proposed TDR and proposed GCR uses a 200m buffer, based on the limited works and best practice.

Following on from the identification of the baseline environment, the available data is utilised to identify and categorise potential effects on the land, soils and geological environment as a result of the proposed project. These assessments are undertaken by:

- Undertaking materials calculations in terms of volumetric soil and subsoil excavation and reuse associated with the design of the development;
- Assessing ground stability risks, in particular peat stability (if present);
- Assessing the combined data acquired and evaluating any likely effects on the soils, geology and ground stability; and
- Identifying effects and considering measures that would mitigate or reduce the identified effects.

The importance/sensitivity of the land, soils and geological receptors was assessed on completion of the desk study and baseline assessment. Using Appendix C of the NRA 2008, as guidance, the land, soils and geological sensitivity criteria is set out in Table 8-2.

Table 8-2 : Estimation of the Importance of Land, Soils and Geology Attributes

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

Overview of Impact Assessment Process

The significance of effects of the proposed project on the Land, Soils and Geological environment has been assessed in accordance with the EPA guidance document 'Guidelines on the Information to be contained in Environmental Impact Assessment Reports (May 2022).' These guidelines are detailed in Chapter 1 (Introduction) of this EIAR.

Magnitude of Impacts

The magnitude of any impact takes into account the likely scale of the predicted change to the baseline conditions, resulting from the predicted impact and considers the duration of the impact i.e., temporary or permanent. The criteria for determining magnitude of impact for the purpose of the Land, Soils and Geology assessment are provided in Table 8-3.

Table 8-3 : Criteria to Determine the Magnitude of Impact and Examples.

Magnitude[1]	Criteria	Typical Examples[2]
High Adverse	Results in loss of attribute	Loss of high proportion of future quarry or pit reserves. Irreversible loss of high proportion of local high fertility soils. Removal of entirety of geological heritage feature. Requirement to excavate / remediate entire waste site. Requirement to excavate and replace high proportion of peat, organic soils and/or soft mineral soils beneath alignment.
Medium Adverse	Results in impact on integrity of attribute or loss of part of attribute	Loss of moderate proportion of future quarry or pit reserves. Removal of part of geological heritage feature. Irreversible loss of moderate proportion of local high fertility soils. Requirement to excavate / remediate significant proportion of waste site. Requirement to excavate and replace moderate proportion of peat, organic soils and/or soft mineral soils beneath alignment.
Low Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	Loss of small proportion of future quarry or pit reserves. Removal of small part of geological heritage feature. Irreversible loss of small proportion of local high fertility soils and/or high proportion of local low fertility soils. Requirement to excavate / remediate small proportion of waste site. Requirement to excavate and replace small proportion of peat, organic soils and/or soft mineral soils beneath alignment.
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either	No measurable changes in attributes

[1] EPA (2022) guidance

[2] Adapted from Box 5.1 from the NRAs Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes

Magnitude[1]	Criteria	Typical Examples[2]
	use or integrity	
Low Beneficial	Results in minor improvement of attribute quality	Minor enhancement of geological heritage feature Remediation of a small, contaminated site (<1ha)
Medium Beneficial	Results in moderate improvement of attribute quality	Moderate enhancement of geological heritage feature Remediation of a medium, contaminated site (<2.5ha)
High Beneficial	Results in major improvement of attribute quality	Major enhancement of geological heritage feature Remediation of a large, contaminated site (>2.5 ha)

Potential impacts may have a negative, neutral or positive effect on the land, soils and geological environment.

Significance of effect

An Impact Assessment Matrix (IAM) is used to determine the significance of an effect. In basic terms, the potential significance of an effect is a function of the sensitivity of the receptor and the magnitude of the impact as shown in Table 8-4.

The matrix provides a framework for the consistent and transparent assessment of predicted effects across all technical chapters; however, it is important to note that individual assessments are based on relevant guidance and the application of professional judgement.

The matrix provides levels of significance of effects ranging from Imperceptible to Profound, as defined in the Environmental Protection Agency (EPA) (2022) EIAR Guidelines. For the purposes of this assessment, effects rated as being "Significant- Moderate" or above are considered to be significant in EIA terms. Effects rated as being "Moderate" are subject to professional judgement in terms of significance, with a rationale provided for this in the main assessment. Effects identified as less than moderate significance are not considered to be significant in EIA terms.

Table 8-4 Impact assessment matrix for determination of significance of effect

Sensitivity of Receptor	Magnitude of Effect			
	High Adverse/ Beneficial	**Medium Adverse/ Beneficial**	**Low Adverse/ Beneficial**	**Negligible**
Very High	Profound	Profound/Significant	Significant/Moderate	Not Significant
High	Profound/ Significant	Significant/ Moderate	Slight/Not Significant	Imperceptible
Medium	Significant	Moderate	Slight	Imperceptible
Low	Moderate/Slight	Slight/Not Significant	Not Significant	Imperceptible

8.3 ASSUMPTIONS AND LIMITATIONS

No overarching assumptions or limitations have been identified that apply to the assessment for Land, Soils and Geology. Where routine assumptions have been made in the course of undertaking the assessment, these are noted in the following sections.

8.4 RECEIVING ENVIRONMENT

The existing environment is described in terms of geomorphology (landscape and topography), superficial and solid geology, and peat stability. The study area is described in Section 8.2 above and outlined in Figure 8-1.

8.4.1 Desk Study

Geological Heritage

The GSI provides scientific appraisal and interpretative advice on geological and geomorphological sites, and is responsible for the identification of important sites that are capable of being conserved as Natural Heritage Areas (NHA).

One Geological Heritage Site is recorded approximately 3.5 km to the west of Turbine no. 1. This is the Knockmealdown gullies, a river channel within extensive gullies. A site report of the Knockmealdown gullies is available through the GSI website[3]. The geological system comprises Holocene age (post-Ice Age) river channels and sandstones of the Knockmealdown Sandstone Formation. No Geological Heritage Sites have been identified within the proposed wind farm site.

Proposed GCR and works areas on the proposed TDR

There are no Geological Heritage Sites within the study area (200m) of the proposed GCR. A number of geological heritage sites are located to the south of the proposed GCR. The nearest geological site (Ballynamuck Boreholes) is located 0.4 km to the south of the existing Killadangan Substation. There are no Geological Heritage Sites within the study area (200m) of the works areas of the proposed TDR.

Geomorphology

The proposed wind farm site is covered with shallow glacial deposits with areas of shallow rock identified resulting in local variations in topography. Post glacial deposits overlay the quaternary deposits.

The landscape is a hilly upland site on the edge of a mountainous area. The proposed wind farm site is located on an elevated area beside the Glenshelane River Valley with a topography of between 130 m and 486 m above Ordnance Datum (AOD). The Knockmealdown Mountains to the north and northwest of the proposed project are also elevated and are the most significant

[3] GSI Geological Site Report - https://gsi.geodata.gov.ie/downloads/Geoheritage/Reports/WD042_Knockmealdown_Gullies.pdf (Accessed June 2024)

landscape features in the surrounding area. A number of deeply incised streams flow from north to south through the area including the Glenshelane and Glennafallia Rivers.

Localised anthropogenic changes to the topography in the form of areas of shallow excavation are also present on the proposed wind farm site due to the historic turf cutting as well as farming and forestry drainage. Plate 8-1 below shows an example of the general topography of the proposed project. The landscape is a hilly upland site with a general fall in topography to the east.

Plate 8-1: Topography of Scart Mountain looking eastwards across the Glenshelane River valley.

Proposed GCR & works areas on the proposed TDR

The proposed GCR varies from 160 mOD at the proposed wind farm substation to 10 mOD at the existing Dungarvan substation with an undulating topography. The proposed cable is along local roads with small section of off-road cable at the Colligan river valley crossing point. Post glacial alluvial deposits overlay the quaternary deposits along the Finisk and Colligan river.

As detailed in Chapter 2 (Description of the Proposed Project), it is proposed that the turbine components will be delivered to the site via Belview Port in south County Kilkenny as shown in Figure 2-3. The proposed works along this route are limited to a few localised places, most of which are previously disturbed ground (e.g. within roundabouts, at the edge of road surfaces and within tilled fields). The locations range from flat to gently sloping.

Land Use

The proposed wind farm site measures 981.4 ha and is predominantly covered in forestry plantation with agricultural land in the northern end – refer to Figure 8-1. Forestry is comprised predominantly of coniferous with some broadleaf areas. The agricultural lands on the site are comprised of rough grassland. The (827ha) whilst the remaining area (at the northern end of the site) comprises third-party owned areas of agricultural lands, and commercial forest. There is an extensive network of existing internal access roads across the proposed wind farm site to facilitate the ongoing forestry operations as well as local access to farmlands.

Biodiversity enhancement lands within the proposed project, will be managed to improve existing habitats as detailed on the Biodiversity Management Plan (Appendix 2-1) and shown on Figure 8-1. The Annex I habitats present on Knocknanask and Knocknasheega are in a poor condition because of long term anthropogenic (i.e. agricultural and forestry) pressures. The aim is that the habitats will reach good condition and favourable conservation status during the estimated duration of the operational phase of the project.

Image 1 Existing access road through proposed Wind Farm site

Proposed GCR and works areas on the proposed TDR

The proposed GCR is approxiamtely 15.5km in length and will traverse in a south-easterly direction from the the proposed wind farm 110kV Substation, to the existing Dungarvan 110 kV Substation. The proposed GCR primarily runs along local roads, with short sections through forestry and agricultural grasslands.

It is proposed that the turbine components will be delivered to the site via Belview Port in south County Kilkenny. The proposed TDR runs from Belview Port, along the national road network until it gets close to the proposed wind farm site , when it turns onto the local road network at the Bogheravaghera Cross Roads (also known as Affane cross). The proposed TDR then continues northwards on the local road network (L1027), before turning onto the L5055 for the final approach to the proposed wind farm site entrance. Passing bays are proposed along the L5055, with the required works detailed in Appendix 1-1. The majority of works required for the proposed TDR are therefore located within the road corridor, however one location at Affane cross is located within an area of scrub and tillage.

Soils and Subsoils

Reference to the Teagasc Soils Data maps (www.gsi.ie) indicates that the proposed project is predominantly covered by shallow acidic soils (Figure 8-2). Soils are classifed as topsoils. Typcial soil examples include podzols, gleys and brown earths. Based on GSI soil mapping this indicates that the proposed project consists of 6 no. types of soil, namely:

- AlluvMIN - Mineral alluvium;
- AminPDPT - Peaty poorly drained (Mainly acidic);
- AminSW - Shallow well drained mineral (Mainly acidic);
- AminSRPT - Shallow, rocky, peaty/non-peaty mineral complexes (Mainly acidic);
- AminDW - Deep well drained mineral (Mainly acidic); and,
- Scree – Scree soils.

General information concerning the Quaternary geology was obtained from GSI online maps and database, which contain subsoil information from the Teagasc/EPA soil and subsoil mapping project. Subsoils are a layer or horizon which immediately underlie the surface soil/topsoil.

Glacial till, derived from Devonian sandstones, is exposed in some areas. Other areas of gravels derived from similar material and from limestones have also been identified, as shown in Figure 8-4.

A limited extent of peat was encountered on Knocknanask to the northwest of the proposed project. The peat areas were largely removed by turf cutting in the c.1950s to 1970s. Remnant turf banks are present however they are not extensive. Areas of shallow peat (i.e., 0.5 m -1.6 m deep) are highlighted in Section 8.4.3 and these are limited and discontinous. An overview of the receiving environment in terms of peat, slope and stability is later set out in in Section 8.4.8.

Plate 8-2 Typical profile - peaty topsoil layer over gravelly glacial till (Knocknanask)

Plate 8-3 Photo from T5 - Knocknanask – soil exposure in the foreground, looking east to Broemountain

Proposed GCR and works areas on the proposed TDR

The proposed GCR is along local roads (Made Ground) with small sections of off road cable at the Colligan river valley crossing point. Post glacial alluvial deposits overlay the quaternary deposits along the Finisk and Colligan river as shown in Figure 8-3. Shallow, rocky, peaty/non-peaty mineral complexes occur near Colligan wood. Alluvial deposits occurs along the Colligan and Figile rover crossing points as shown in Figure 8-4.

The proposed TDR will utilise regional and local road corridors (Made Ground) with a short off-road section to the northeast of Affane Crossroads. The soils at the off-road section at Affane crossroads are comprised of a combination of well drained and poorly drained soils as shown in Figure 8-4.

7°50'0"W
7°45'0"W
7°40'0"W
52°13'20"N
52°10'0"N
52°6'40"N
608000
601000
594000
609050
617100
625150

Scree
BktPt
RckNCa
Water
Cut
TDSs
TLs
A
L
GDSs
FenPt
RckCa
Mesc
Mbs

Legend

- Proposed project
- Proposed infrastructure footprint within the proposed wind farm site
- Proposed Turbine Delivery Route works areas

Soil Type

- AlluvMIN - Mineral alluvium
- AminDW - Acid Brown Earths / Brown Podzolics
- AminPD - Surface water Gleys / Ground water Gleys Acidic
- AminPDPT - Peaty Gleys Acidic
- AminSP - Surface water Gleys / Ground water Gleys Shallow
- AminSPPT - Peaty Gleys Shallow
- AminSRPT - Podzols Peaty
- AminSW - Lithosols / Regosols
- BktPt - Blanket peat
- BminDW - Grey Brown Podzolics / Brown Earths Basic
- BminSP - Surface water Gleys / Ground water Gleys Shallow
- BminSRPT - Lithosols Peats
- BminSW - Renzinas / Lithosols
- Cut - Raised Bog cutaway/cutover
- FenPT - Fen peat
- Lac
- Made
- MarSands
- MarSed
- Scree
- Water

0 1.5 3
Kilometres

NOTES

1. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING\
2. ALL DRAWINGS TO BE CHECKED BY THE CONTRACTOR ON SITE\
3. ENGINEER TO BE INFORMED OF ANY DISCREPANCIES BEFORE ANY \ WORK COMMENCES\
4. ALL LEVELS RELATE TO ORDNANCE SURVEY DATUM AT MALIN HEAD

Rev	Date	Description	By	Chkd.
A	12/12/2024	First issue	S.P	J.S

Client: Ireland FuturEnergy

Project: Scart Mountain Wind Farm

Title: Figure 8-2 Soils Map

Scale @ A3: 1:60,000

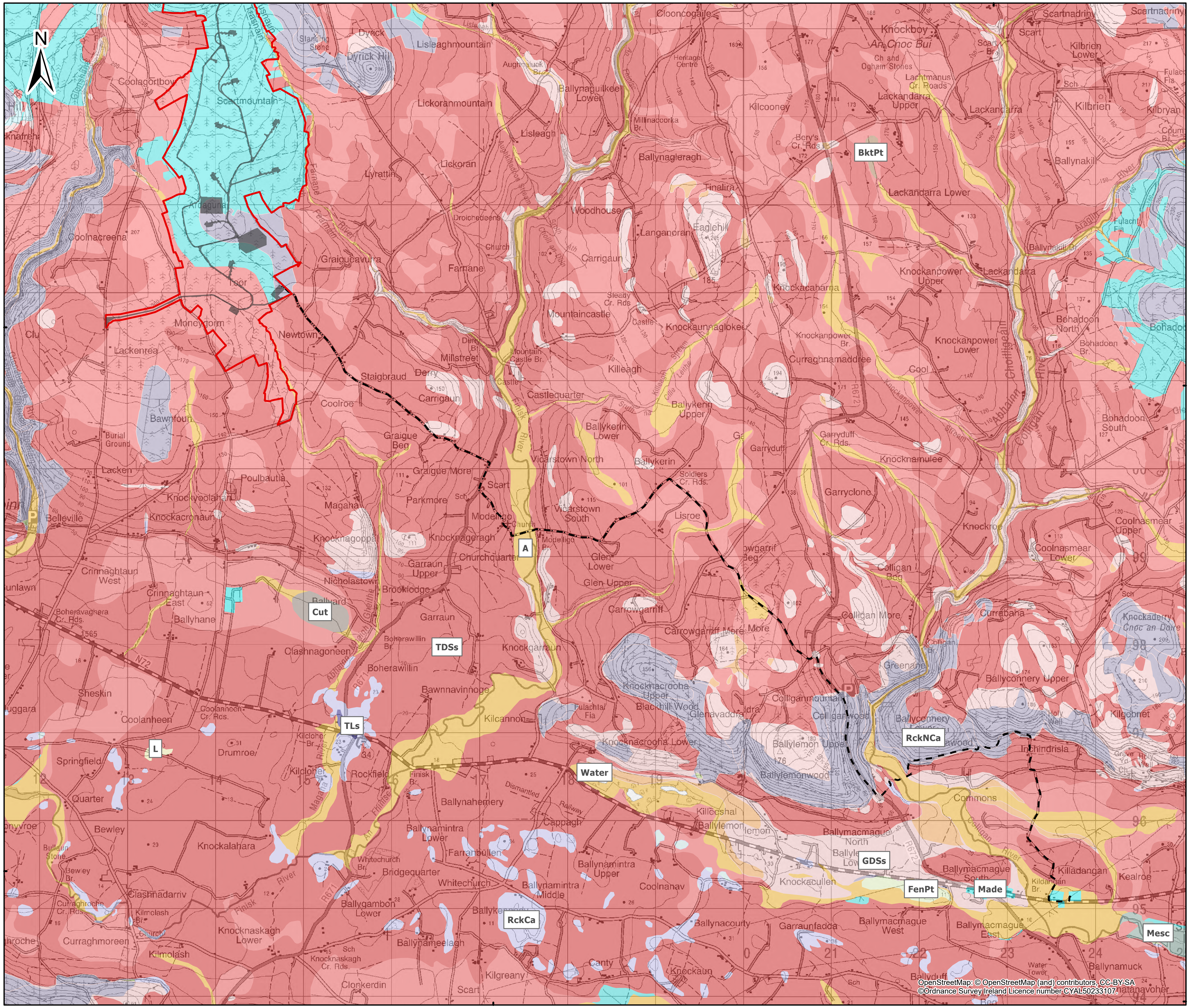
Prepared by: S.Pezzetta | Checked by: J.Staunton | Date: December 2024

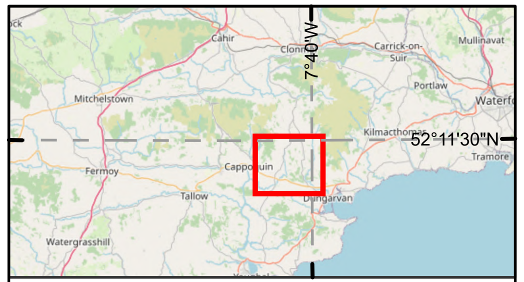
TOBIN
Tel: +353-(0)1-8030406
Email: info@tobin.ie
www.tobin.ie

Map Ref: 11303-019-SO-S.BO-TOB-A

Draft: A

OpenStreetMap: © OpenStreetMap (and) contributors, CC-BY-SA
©Ordnance Survey Ireland Licence number CYAL50233107.





Legend

- Proposed Wind Farm Site
- Proposed infrastructure footprint within the proposed wind farm site
- Proposed Grid Connection Route

Soil Type

- AlluvMIN - Mineral alluvium
- AminDW - Acid Brown Earths / Brown Podzolics
- AminPD - Surface water Gleys / Ground water Gleys Acidic
- AminPDPT - Peaty Gleys Acidic
- AminSP - Surface water Gleys / Ground water Gleys Shallow
- AminSPPT - Peaty Gleys Shallow
- AminSRPT - Podzols Peaty
- AminSW - Lithosols / Regosols
- BktPt - Blanket peat
- BminDW - Grey Brown Podzolics / Brown Earths Basic
- BminSP - Surface water Gleys / Ground water Gleys Shallow
- BminSRPT - Lithosols Peats
- BminSW - Renzinas / Lithosols
- Cut - Raised Bog cutaway/cutover
- FenPT - Fen peat
- Lac
- Made
- MarSed
- Water

0 1 2
Kilometers

NOTES

1. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING\
2. ALL DRAWINGS TO BE CHECKED BY THE CONTRACTOR ON SITE\
3. ENGINEER TO BE INFORMED OF ANY DISCREPANCIES BEFORE ANY \ WORK COMMENCES\
4. ALL LEVELS RELATE TO ORDNANCE SURVEY DATUM AT MALIN HEAD

A	12/12/2024	First issue	S.P	J.S
Rev	Date	Description	By	Chkd.

Client: FuturEnergy Ireland

Project: Scart Mountain Wind Farm

Title: Figure 8-3: Proposed Grid Connection Route Soils Map

Scale @ A3: 1:40,000

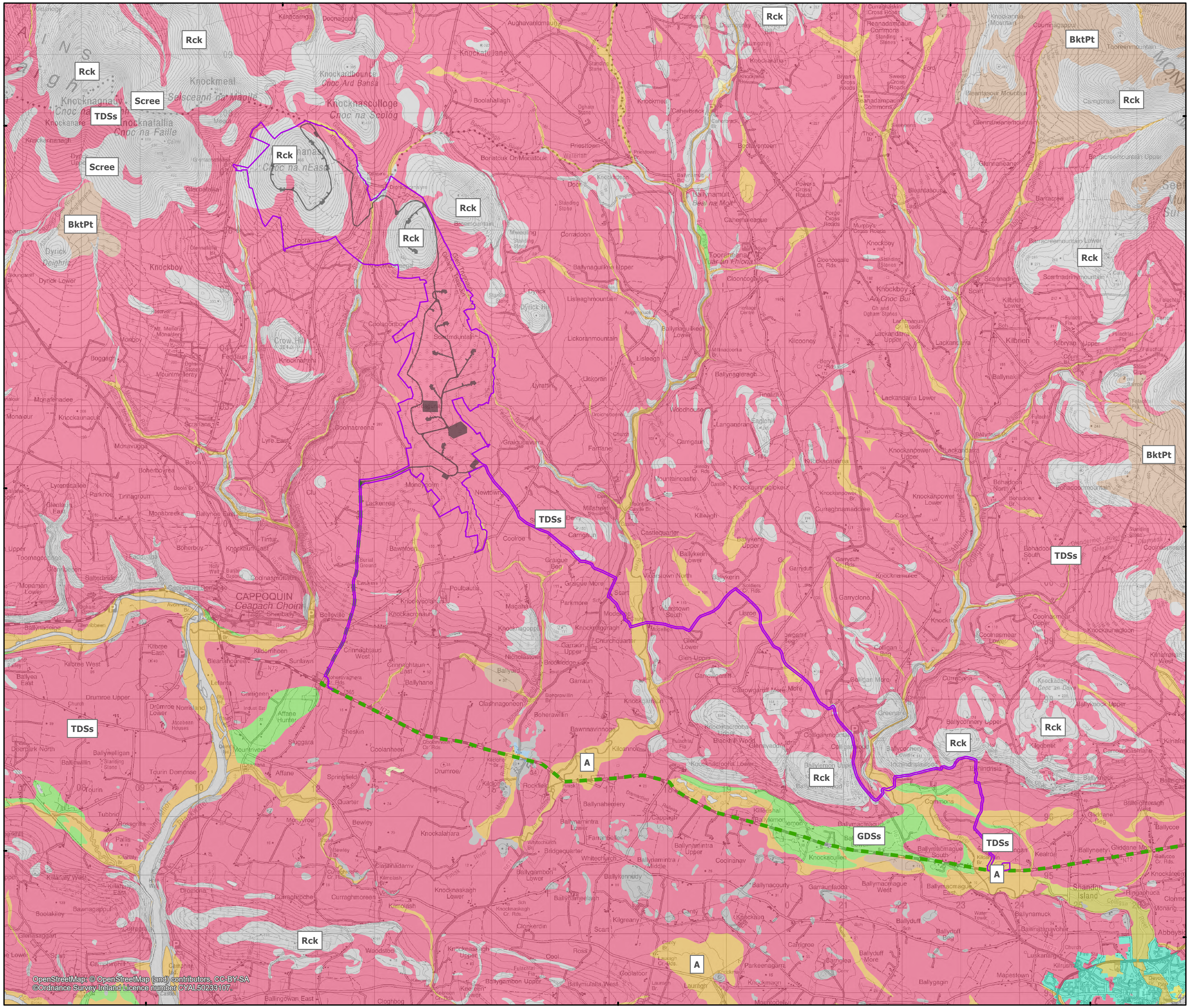
Prepared by: S.Pezzetta
Checked by: J.Staunton
Date: December 2024

TOBIN

Tel: +353-(0)1-8030406
Email: info@tobin.ie
www.tobin.ie

Map Ref: 11303-026-SO-PGR-TOB-A

Draft: A



Legend

- Proposed project
- Proposed infrastructure footprint within the proposed wind farm site

Quaternary Sediments

- A, Alluvium
- BktPt, Blanket Peat
- Cut, Cut over raised peat
- FenPt, Fen Peat
- GDSs, Gravels derived from Devonian sandstones
- KaRck, Kartsified bedrock outcrop or subcrop
- L, Lacustrine sediments
- Mbs, Marine beach sands
- Mesc, Esturine silts and clays
- Rck, Bedrock outcrop or subcrop
- Scree, Scree
- TDSs, Till derived from Devonian sandstones
- TLs, Till derived from limestones
- Urban
- Water

0 1.5 3
Kilometres

NOTES

1. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING\
2. ALL DRAWINGS TO BE CHECKED BY THE CONTRACTOR ON SITE\
3. ENGINEER TO BE INFORMED OF ANY DISCREPANCIES BEFORE ANY \ WORK COMMENCES\
4. ALL LEVELS RELATE TO ORDNANCE SURVEY DATUM AT MALIN HEAD

A	12/12/2024	First issue	S.P	J.D
Rev	Date	Description	By	Chkd.

Client: FuturEnergy Ireland

Project: Scart Mountain Wind Farm

Title: Figure 8-4 Subsoils Map

Scale @ A3: 1:60,000

Prepared by:	Checked by:	Date:
S.Pezzetta	J.Dillon	December 2024

TOBIN

Tel: +353-(0)1-8030406
Email: info@tobin.ie
www.tobin.ie

Map Ref: 11303-020-SSO-S.BO-TOB-A

Draft: A

Bedrock Geology

Information on the bedrock geology was obtained from the Geology of Waterford, Sheet No. 22 (1:100,000) and accompanying booklet published by the GSI[4].

The proposed wind farm site is underlain by the Knockmealdown Sandstone Formation which is comprised of medium grained pink-purple sandstone as illustrated in Figure 8-5 . There are also several bedrock exposures on the proposed wind farm site .

There are no mapped faults within the proposed wind farm site. Faults within the Knockmealdown Sandstone formation are present to the east and west, typically orientated in a northeast southwest direction.

Proposed GCR and works areas on the proposed TDR

The proposed GCR is underlain predominantly by the Knockmealdown Sandstone Formation with a number of other formations including the Kiltorcan Formation, Ballysteen, Ballytrasna and Waulsortian Formation as shown on Figure 8-5.

The geology underlying the works areas of the proposed TDR route between the N72 (at Boheravaghera Cross, also known as Affane Cross) and the proposed wind farm site, is comprised of Waulsortian Formation limestones. The proposed TDR is along existing national roads, underlain predominantly by the Knockmealdown Sandstone Formation with a number of formations including the Kiltorcan Formation, Ballysteen, Ballytrasna and Waulsortian Formation.

[4] Sleeman, A.G. and McConnell, B.J. 1995. Geology of East Cork - Waterford. A geological description of east Cork, Waterford and adjoining parts of Tipperary and Limerick to accompany the Bedrock Geology 1:100,000 map series, sheet 22, East Cork - Waterford. Geological Survey of Ireland.

7°50'0"W
7°45'0"W
7°40'0"W
52°13'20"N
52°10'0"N
52°6'40"N
608000
601000
594000
609050
617100
625150

DUSHES
DUTREA
DUCLIN
DUKFRE
DUBTRAD
DUKMDN
DUBTRA
CDBMTN
CDBALL
DUKILT
CDWAUL
DUGYLE
DUGYLE2
DUGYLE3
CDCROW
CDLLS

Legend

- Proposed project
- Proposed infrastructure footprint within the proposed wind farm site
- Proposed Turbine Delivery Route

Bedrock

- Ballysteen Formation
- Ballymartin Formation
- Crows Point Formation
- Lower Limestone Shale
- Waulsortian Limestones
- Ballytrasna Formation
- Doon Lava Member
- Coumaraglin Formation
- Gyleen Formation
- Ballyquinn Member
- Ardmore Member
- Kilnafrehan Conglomerate Formation
- Kiltorcan Formation
- Knockmealdown Sandstone Formation
- Sheskin Formation
- Treanearla Formation

0 1.5 3
Kilometres

NOTES

1. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING\
2. ALL DRAWINGS TO BE CHECKED BY THE CONTRACTOR ON SITE\
3. ENGINEER TO BE INFORMED OF ANY DISCREPANCIES BEFORE ANY \ WORK COMMENCES\
4. ALL LEVELS RELATE TO ORDNANCE SURVEY DATUM AT MALIN HEAD

Rev	Date	Description	By	Chkd.
A	12/12/2024	First issue	S.P	J.S

Client: Ireland FuturEnergy

Project: Scart Mountain Wind Farm

Title: Figure 8-5 Bedrock Geology

Scale @ A3: 1:60,000

Prepared by:	Checked by:	Date:
S.Pezzetta	J.Staunton	December 2024

TOBIN
Tel: +353-(0)1-8030406
Email: info@tobin.ie
www.tobin.ie

Map Ref: 11303-021-B.GEO-S.BO-TOB-A

Draft: A

Mineral/Aggregate Resources

The GSI database indicates that there are no active quarries, and no mineral locations present within the proposed wind farm site. There are no active quarries within 2km of the proposed wind farm site.

Contaminated Land

An evaluation was undertaken to determine the presence and extent of potentially contaminated land or contaminated sites in the study area (using EPA historical data and the Section 22 Register). This evaluation is based on the identification of potential sources, pathways and receptors. As the proposed wind farm site is predominantly covered in forestry with some agriculure, the potential for contamination is very low. Exisitng land management activities includes fertilizer application and scrub management. No evidence of hydrocarbons was encountered during the site investigation works. No evidence of contamination was encountered on the proposed GCR or TDR works areas.

A review of the EPA website for existing and historic licensed and illegal waste activities, mines and industries was carried out to identify any potential contamination sources and any potential contaminating activities present within the study area of the proposed project.

Waste and Industrial Emissions Facilities

The EPA online maps (www.epa.ie) contain a point dataset of Industrial Emissions Licensing facilities. The EPA is the competent authority for granting and enforcing Industrial Emissions (IE) licences for specified industrial and agriculture activities listed in the First Schedule to the Environmental Protection Agency Act 1992 as amended. There are no waste facility licences within the study area of the proposed project.

Integrated Pollution Control (IPC) Sites

The EPA/WFD online water maps contain a points dataset of Integrated Pollution Control (IPC) sites. The EPA has been licensing certain activities since 1994.

There are no IE/IPC licenced sites within the proposed wind farm site however there are two surrendered licenceslocated within the study area of the proposed wind farm site. These are along the Glenshelane River 1.6 km to the south and west of the proposed wind farm site (Licence refs: P0885 and P0907).

The desk study indicated that no illegal waste activities were known within the study area of the proposed project. No on-site evidence of contamination was detected for the proposed wind farm site and the proposed GCR and TDR works areas.

Geohazards

Karst Features

The GSI Karst database was consulted for records of locations and types of reported karst features. There are no karst features reported to be located at the proposed wind farm site . Due

to the known sandstone geology on the proposed wind farm site, the potential to encounter unreported karst features is negligible.

Proposed GCR and works areas of the proposed TDR

There are no reported karst features on the proposed GCR.The nearest karst features to the proposed GCR are a series of enclosed depressions located 0.4 km to the south at Ballnamuck.

Similarly, there are no reported karst features on the works areas of the proposed TDR. The nearest karst features are a series of swallow holes, springs and elcosed depressions located to the east and west of the proposed TDR works areas, within the vicinity of the L1027. The closed karst feature is a swallow hole, located 205m to the west of the proposed TDR works areas, approximatly 0.7km to the north of Affanne crossroads.

Peat and Slope Stability

There are no known peat instability issues within the study area of the proposed wind farm site.

The GSI web resource indicates the nearest related slope stability events occurred on elevated sites to the north and west of the proposed wind farm site. A peat stability risk assessment (PSRA) has been undertaken for the proposed wind farm site. The full report is outlined in Appendix 8.1, with peat depths recorded from site surveys outlined in Figure 8-6.

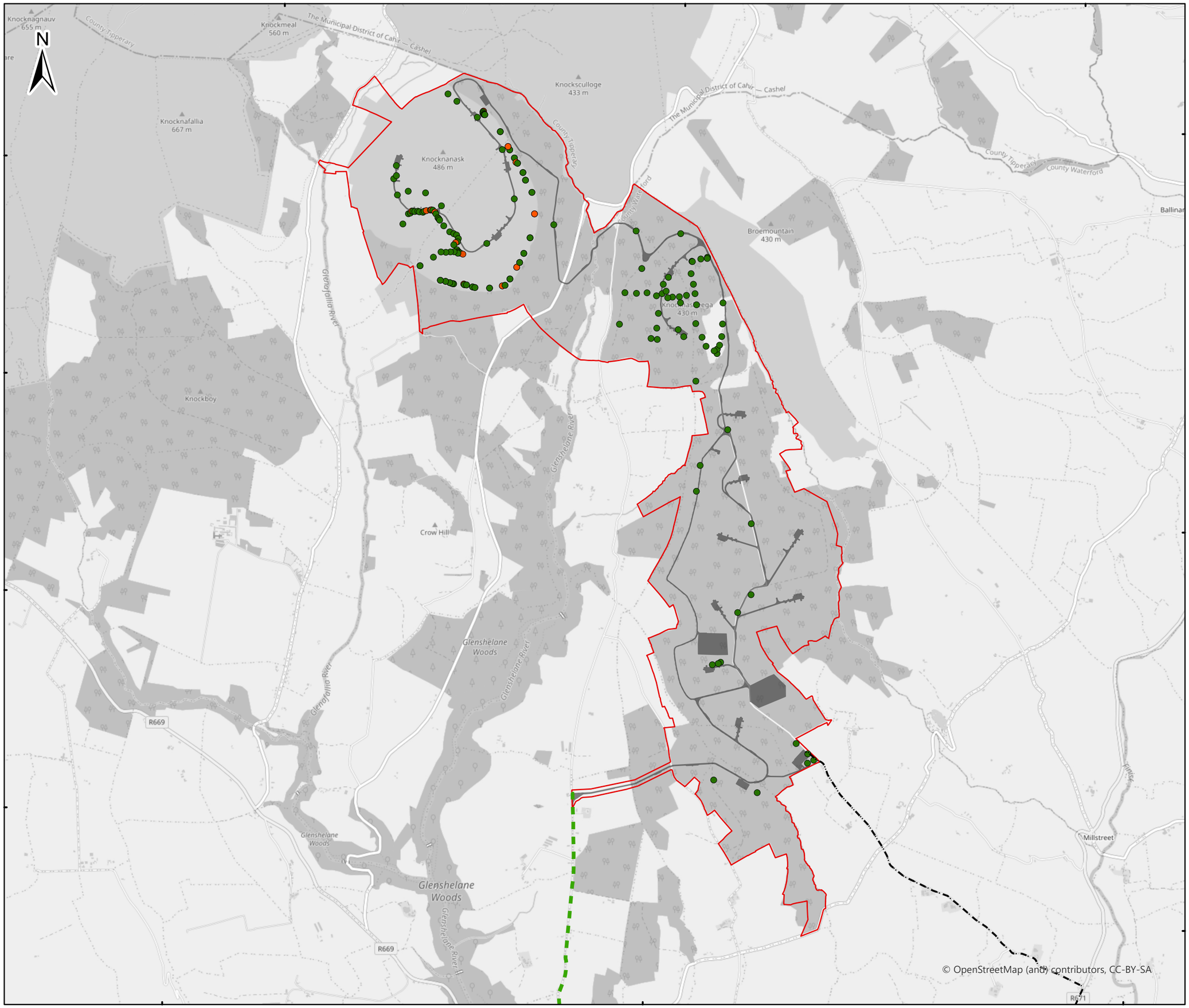
The GSI database provides information on locations, types, and frequencies of landslide events. This database contains no records of landslide events in the study area. The nearest recorded peat related event is located on an elevated afforested site, approximately 5 km west of the proposed wind farm site (GSI_LS14-0129). The landslide was recorded within a peat area to the top of Knockmealdown at an elevation of c.660 m AOD. The location is within a corrie,[5] with a northeast slope aspect. Due to the isolated location and limited extent, no apparent damage occurred. The underlying subsoils were scree and rock.

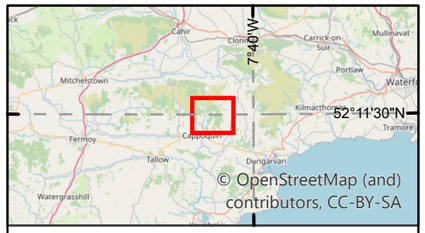
Peat depth information (both probed and extrapolated depths) was used to determine the excavation volumes for each of the main infrastructure elements.

Proposed GCR and works areas of the proposed TDR

There are no recorded landslide events along the proposed GCR or at the proposed TDR works areas.

[5] A corrie is a bowl/amphitheatre shaped hollow area formed by glaciation. Corries typically have three steep sides, including a high back wall, with a low-lying 'lip' facing down valley.





Legend

- Proposed Wind Farm Site
- Proposed infrastructure footprint within the proposed wind farm site
- Proposed Grid Connection Route

Peath Depth (m)

- ≤ 0.50
- 0.5- 0.7

0 500 1,000
Meters

NOTES

1. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING\
2. ALL DRAWINGS TO BE CHECKED BY THE CONTRACTOR ON SITE\
3. ENGINEER TO BE INFORMED OF ANY DISCREPANCIES BEFORE ANY \ WORK COMMENCES\
4. ALL LEVELS RELATE TO ORDNANCE SURVEY DATUM AT MALIN HEAD

Rev	Date	Description	By	Chkd.
A	12/12/2024	First issue	S.P	J.S

Client: Ireland FuturEnergy

Project: Scart Mountain Wind Farm

Title: Figure 8-6 Peat Depth

Scale @ A3: 1:30,000

Prepared by:	Checked by:	Date:
S.Pezzetta	J.Staunton	December 2024

TOBIN
Tel: +353-(0)1-8030406
Email: info@tobin.ie
www.tobin.ie

Map Ref: 11303-023-P. DEP-S.BO-TOB-A

Draft: A

8.4.2 Field Surveys

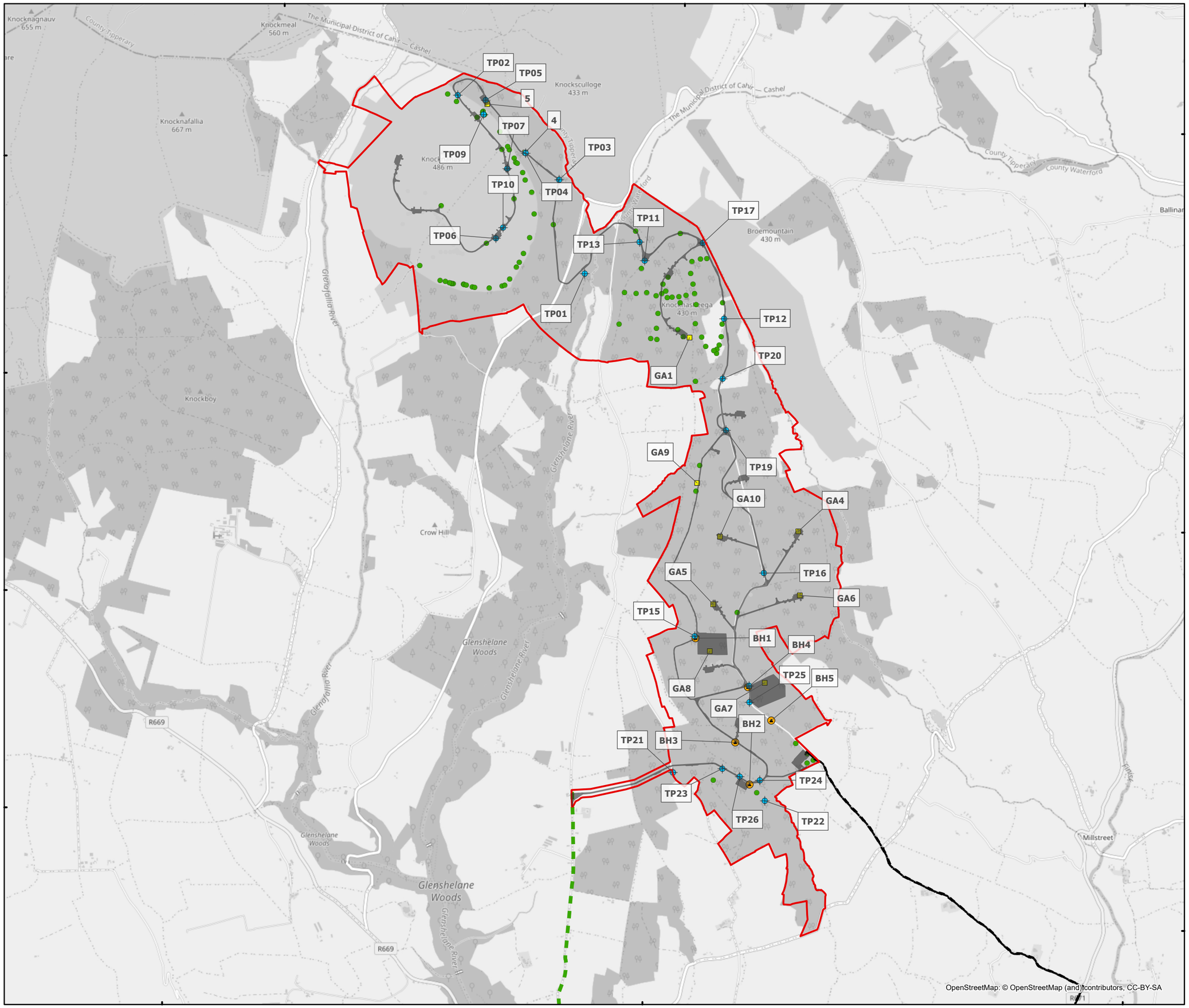
Proposed wind farm site

The ground investigation (GI) methodology is described in Section 8.2 above.

The GI results are summarised in Table 8-5 and the site investigation locations are shown in Figure 8-7.Based on the site walkovers, shallow peat and peaty topsoil were encountered at T1 to T7 inclusive. Peat probes were concentrated in the areas of shallow peat with additional probing to the south near the proposed substation and borrow pits. No peat was encountered at T8 to T15, at the borrow pits or on the site substation.

Regular sampling and in-situ testing was undertaken in the exploratory holes to facilitate the geotechnical descriptions and to enable laboratory testing to be carried out on the soil samples recovered during excavation and drilling. The procedures used in this site investigation are in accordance with Eurocode 7 Part 2: Ground Investigation and testing (ISEN 1997 – 2:2007) and B.S. 5930:2015. Geotechnical testing consisting of moisture content, Atterberg limits, Particle Size Distribution (PSD), MCV, MCV relationship and MCV Compaction testing were carried out in National Materials Testing Laboratory's Geotechnical Laboratory in Carlow.

The geotechnical testing (Appendix 2-9) carried out on soil samples recovered generally confirm the descriptions on the logs with the primary constituent of the cohesive deposits found to be a CLAY of low to intermediate plasticity. The Particle Size Distribution (PSD) tests confirm that the cohesive deposits are generally well-graded with percentages of sands and gravels ranging between 4.80% and 50.8% generally with fines contents of 23.5% to 50.8%. The Moisture Content Value (MCV) result in TP12 and TP15 of 10.8 and 13.1 respectively are indicative of a stiff cohesive deposit. No peat was encountered at the proposed substation location.



Legend

- Proposed Wind Farm Site
- Proposed infrastructure footprint within the proposed wind farm site
- Proposed Grid Connection Route
- Proposed Turbine Delivery Route

Site investigations

- TP Locations
- Peat probes
- Boreholes
- Gouge Auger

0 0.75 1.5
Kilometres

NOTES

1. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING\
2. ALL DRAWINGS TO BE CHECKED BY THE CONTRACTOR ON SITE\
3. ENGINEER TO BE INFORMED OF ANY DISCREPANCIES BEFORE ANY \ WORK COMMENCES\
4. ALL LEVELS RELATE TO ORDNANCE SURVEY DATUM AT MALIN HEAD

Rev	Date	Description	By	Chkd.
A	12/12/2024	First issue	S.P	J.S

Client: FuturEnergy Ireland

Project: Scart Mountain Wind Farm

Title: Figure 8-7 Site Investigation Location Map

Scale @ A3:	1:30,000	
Prepared by:	Checked by:	Date:
S.Pezzetta	J.Staunton	December 2024

TOBIN
Tel: +353-(0)1-8030406
Email: info@tobin.ie
www.tobin.ie

Map Ref: 11303-022-S.INV-S.BO-TOB-A

Draft: A

Table 8-5: Turbine locations - Site Investigation- Surface Layer and Underlying Subsoils

Turbine	Depth	Description – Surface Layer	Subsoil
1	0 to 0.5	Dark brown sandy slightly gravelly fibrous PEAT with rootlets.	Brownish red slightly sandy gravelly CLAY with many angular to sub angular cobbles and boulders
2	0 to 0.3	Dark brown sandy slightly gravelly fibrous PEAT with rootlets. Peaty topsoil	Brownish red slightly sandy gravelly CLAY with many angular to sub angular cobbles and boulders
3	0.1 to 0.4	Brown slightly sandy slightly gravelly TOPSOIL with grass and rootlets. Peaty topsoil	brownish grey slightly sandy gravelly CLAY with many angular to sub angular cobbles and boulders
4	0 to 0.1	Brown slightly sandy spongy pseudo-fibrous PEAT with organic matter and rootlets. Peaty topsoil	light grey, brown slightly sandy gravelly CLAY
5	0.1	Soft dark PEAT with rootlets. Peaty topsoil	brownish grey slightly sandy gravelly CLAY with many angular to sub angular cobbles and boulders
6	0 to 0.4	Black slightly sandy slightly gravelly TOPSOIL with grass and rootlets. Peaty topsoil	brown slightly sandy gravelly slightly silty CLAY with some sub angular to sub rounded cobbles and boulders
7	0.25	Soft dark brown slightly sandy slightly gravelly PEAT with grass and rootlets. Peaty topsoil	Firm reddish brown slightly sandy gravelly slightly silty CLAY with some sub angular to sub rounded cobbles and boulders
8	0	No peat	Firm reddish brown slightly sandy gravelly CLAY with some sub angular to sub rounded cobbles and boulders
9	0	No peat	Soft to firm brown slightly sandy slightly gravelly CLAY.
10	0	No peat	brown slightly sandy gravelly CLAY with occasional sub angular to sub rounded cobbles

Turbine	Depth	Description – Surface Layer	Subsoil
11	0	No peat	Soft to firm brown slightly sandy slightly gravelly CLAY.
12	0	No peat	Soft to firm brown sandy slightly gravelly CLAY. Some cobbles and boulders.
13	0	No peat	Soft to firm brown sandy slightly gravelly CLAY. Frequent cobbles
14	0	No peat	Soft to firm brown sandy slightly gravelly CLAY. Frequent cobbles
15	0	No peat	Soft to firm brown sandy slightly gravelly CLAY. Frequent cobbles

8.4.2.2 Borrow Pits

Two borrow pit areas are proposed, as detailed below. The borrow pit selection was based on the following factors:

- Avoidance of peat;
- Avoidance of potential ecological/ornithological receptors; and
- Avoidance of bioclass areas/Annex I habitats.

The proposed borrow pits avoided areas of peatland/heath, Coillte bioclass areas and Annex I habitats. The field surveys refined and confirmed the location of the borrow pits, which are located between Turbines 13 and 15. Based on the desk and field surveys, ground conditions generally consist of sandstone till over sandstone bedrock (Knockmealdown Sandstone Formation). A total of four boreholes were undertaken near the borrow pit areas.

Borrow Pit - Area 1 is overlain by topsoil underlain predominantly by firm brown slightly sandy very gravelly CLAY with many angular to sub angular cobbles and boulders. Possible bedrock was encountered at 2.3 m. No peat was encountered. The borrow pit material comprises suitable fill material.

Borrow Pit - Area 2 is located to the east of the substation. Trial pits encountered stiff brown slightly sandy gravelly CLAY with many subangular to subrounded cobbles and boulders as summarised below. In addition, geotechnical tests were undertaken with results included in Appendix 2-9. The material could be used with geotextiles for the base layers of the proposed Wind Farm roads. Stone is required for the final surface or capping layer and will be sourced from off-site, appropriately authorised quarries. Possible bedrock was encountered during the

trial pitting undertaken at this location. The potential material is summarised below in Table 8-6.

Table 8-6: Borrow Pit - Potential Material Volumes and Summary of the Area Characteristics

Area	Material Type	Potential Volume (m^3)	Ecological/Other Constraints
1	Gravelly sandy CLAY with frequent cobbles, possible bedrock at 2.5 m.	>300,000 t 6 m x 30,000 m^2 180,000 m^3 x 2t/m^3 Overburden 50,000 m^3	No significant ecology constraints, no peat encountered
2	Gravelly sandy CLAY with frequent cobbles, possible bedrock at 2.5 m.	>300,000 t 6 m x 30,000 m^2 180,000 m^3 x 2t/m^3 Overburden 50,000 m^3	No significant ecology constraints, no peat encountered

The deterministic assessment takes account of:

- Slope angle, as derived from LiDAR digital terrain model data,
- Material strength, as derived from site-specific ground investigation and comparable experience,
- Likely loadings during the construction period, and
- Extreme weather events.

The calculations are formulated in accordance with Eurocode 7, where partial factors are applied to soil strength parameters and loadings to achieve a satisfactory level of reliability in the design. All overdesign factors (ODF) were greater than 1.0 (i.e. 3.2 or greater), indicating that the stability is satisfactory in both short term (undrained) and long term (drained) condition. Hence, a general *"low"* to *"negligible"* risk rating for peat instability is appropriate for the proposed development. For the case of Turbines 2 and 6, local deterministic risk assessments have downgraded the risk to what would be considered *"low"*. This is due to the relatively shallow depths of peat encountered during ground investigations (0.2 to 0.4m).

The deposition of peat is also assessed but to the potential for effects of soil stability. Excavation of peat and subsoil will be required for construction of works for the installation of access roads. This will result in a permanent removal and relocation of cutover peat and subsoil. Estimated volumes of peaty soils is 13,000 m^3. There is no loss of peat or subsoil, as it will all be permanently relocated within the proposed wind farm site to the borrow pits. A illustration of the borrow pits backfill is included in Image 1 below.

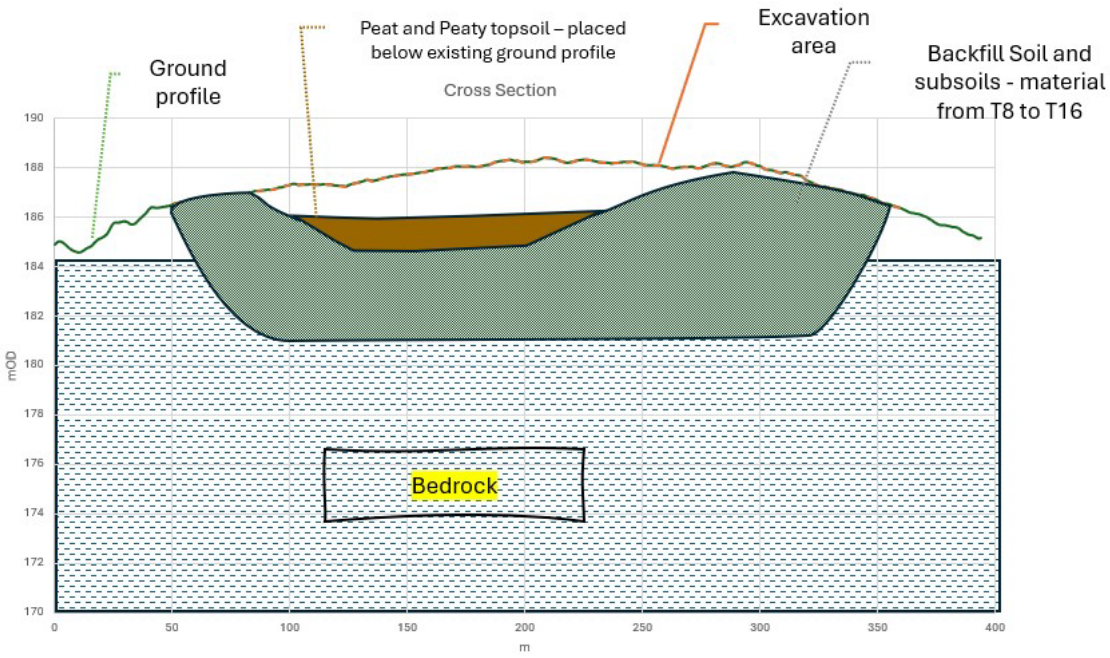


Image 1 Borrow Pit backfill

Proposed GCR and works areas of the proposed TDR

Shallow excavations are required for the proposed GCR. The standard trench is 0.6m wide by 1.25m deep with horizontal directional drilling (HDD) proposed for river crossings. A site walkover was undertaken in January 2024 of the proposed GCR at the River Colligan and River Figile crossings.

No peat was recorded on the proposed GCR. Bedrock was noted in the stream bed upgradient of the River Colligan crossing point with sand and gravel alluvial deposits on the stream banks. A borehole (BH05), was undertaken at the River Coligan crossing. Clayey SAND and Clayey GRAVEL was encountered to 4.3m bgl. The subsoil was underlain by medium strong to strong thinly laminated reddish brown medium grained SANDSTONE and SILTSTONE.

Limited works are required on the proposed TDR. A site walkover was undertaken in November 2023 of the proposed TDR from the N72. The proposed works near Boheravaghera cross will involve works within an agricultural (tillage) field. The soils comprised of brown topsoils and light brown/brown well drained very sandy gravelly SILT. No peat was recorded on the works areas of the proposed TDR.

8.5 POTENTIAL EFFECTS

The environmental effects of the proposed project on Land, Soils and Geology are discussed and assessed in the following sections. The 'do-nothing' scenario is reviewed, and potential effects are assessed for three stages of the proposed project life cycle; (i.e., construction, operation, and decommissioning) in addition to the cumulative scenario.

8.5.1 Do-Nothing Scenario

The do-nothing situation relevant to Land, Soils and Geology is one where the proposed project does not proceed. Within the proposed project boundary, forestry management, including thinning, felling, extraction and replanting, and agricultural management would be expected to continue in a manner similar to the current activity. There is limited potential for intensification to alter the agricultural land use on Knocknanask to the north of the proposed wind farm site.

Agricultural and forestry management in the wider study area would also be expected to continue as per current practices in the short to medium term. There are no significant effects to the existing Land, Soils and Geology conditions based on a do-nothing scenario.

Proposed GCR & works areas of the proposed TDR

There are no significant effects to the existing Land, Soils and Geology conditions along the proposed GCR and on the works areas on the proposed TDR based on a do-nothing scenario. In areas of forestry along the proposed GCR, forestry management practices, including thinning, felling, extraction and replanting, and agricultural management would be expected to continue in a manner similar to the current activity. Agricultural activity and forestry management (along the proposed GCR), will be maintained in accordance with current management in the short to medium term.

8.5.2 Potential Effects - Construction Phase

The direct and indirect effects of the construction activities on Land, Soils and Geology are assessed further in the following sections. This section presents an assessment in the absence of any mitigation measures, with the exception of embedded mitigation that has been incorporated into the design (e.g. avoiding sensitive features through the siting of the proposed project during the scoping and initial assessment). Measures have been proposed in Section 8.6 to reduce or mitigate the effects, and the residual effects after the application of mitigation measures are reported in Section 8.7. Measures included in the Construction Environmental Management Plan (CEMP) such as bunding were reviewed.

Effects on Geological Heritage Sites

There are no geological heritage sites on the proposed wind farm site and study area. No direct or indirect effects were identified on Geological Heritage Site features.

Proposed GCR & works areas of the proposed TDR

There are no geological heritage areas on the proposed GCR or at works areas on the proposed TDR. No potential direct or indirect effects were identified on Geological Heritage Sites along the proposed GCR or on the works areas on the proposed TDR as a result of the proposed project.

Effects on Land Use

The proposed wind farm site is predominantly covered in forestry and agricultural lands. There is a network of existing roads/tracks facilitating existing forestry and farm developments. The main effect of the proposed project with regard to land use is the removal of vegetation (including forestry, along with some agricultural land.

There will be a change in land use associated with the proposed project. A total of 37.8 ha will be utilised for the construction phase on the proposed wind farm site, with 25.6 ha utilised for the operational phase.

The land uses in the proposed wind farm site are not economically important and do not have other geological or geomorphological attributes that are of significance. Hence, the importance/sensitivity of the geological environment is considered to be low. The sensitivity of the forestry/agricultural lands, is low and the magnitude is low adverse. Therefore, the effect of the proposed project with regard to land use change, is considered not significant, negative, certain and long-term.

There are no indirect effects anticipated on land use as a result of the proposed project.

Proposed GCR and works areas of the proposed TDR

The proposed GCR is predominantly in the existing road corridor and where the proposed GCR does leave the public road corridor, it maximises the use of existing farm/forest tracks. The GCR lands use is mainly local roads with a small section off road agricultural land for the HDD crossings. The land use for the proposed GCR is therefore classified as a low sensitivity receptor as they are predominantly within the road network. The land in the proposed GCR are localised, are not economically important and do not have other geological or geomorphological attributes that are of significance. Hence, the importance/sensitivity of the geological environment is considered to be low. The magnitude of effect is assessed as low adverse. Therefore, given the low sensitivity and the low adverse magnitude rating, the effect on land use due to the construction of the GCR is considered not significant, negative, certain, and permanent.

Limited works are required to undertake the works are on the proposed TDR, with the majority of these at Affane Crossroads and along the L5055. With the exception of the TDR works at Affane Cross, these will also be located in the public road corridor, therefore resulting in no change to land use. Due to the limited and temporary land take for the works areas on the proposed TDR at Affane Cross (changing a small area from agricultural use to transportation temporarily), it is considered that the sensitivity is low and the magnitude is negligible. Therefore, there will be an imperceptible, negative and temporary effect, due to land use change i.e. soil stripping and reinstatement/landscaping works. The road widening works and passing bays along the L5055 will be located within the road corridor, so their effect, although permanent will be not significant.

Effects on Contaminated Sites/Potential for contamination

Contaminated sites

No contaminated sites were identified in the study area of the proposed project.

The sensitivity of the soils and subsoils is low and the magnitude is negligible. Pre-mitigation potential effects on previously contaminated sites are therefore considered to be imperceptible.

Potential for contamination

Construction machinery and equipment contain various vehicle fluids/ oils and fuels (hydrocarbons) which have the potential to contaminate the site through leaks and/ or spills. The components of the proposed infrastructure (including turbines, roads, substation and construction compounds) will be excavated and moved using excavators, wheeled dumpers, HGVs and bulldozers. Fuel will be required to supply the required machinery and will be stored at the construction compounds. Potential leaks or spills from construction activities within the proposed wind farm have the potential to pollute the soils and geology environment. Due to the presence of shallow bedrock and greenfield soils the sensitivity is medium. The sensitivity of the soils and subsoils is medium and the magnitude is low adverse. Pre-mitigation potential effects are therefore considered to be slight, localised and short term [not significant] on the potential for contamination of soils and subsoils within the proposed wind farm site.

Proposed GCR and works areas of the proposed TDR

Contaminated sites

An evaluation was undertaken to determine the presence and extent of potentially contaminated land along the proposed GCR and works areas on the proposed TDR. No contaminated sites were identified. Due to the limited area of soil disturbance on the off road sections, the magnitude is negligible.

The sensitivity of the soils and subsoils is low and the magnitude is negligible. Pre-mitigation potential effects relating to contaminated sites along the proposed GCR and works area on the proposed TDR are considered imperceptible.

Potential for contamination

Wherever there are vehicles and plant in use, there is the potential for hydrocarbon release which may contaminate the soil and subsoil. Any spills and leaks to ground will be contained locally based on the project design and will be attenuated in the subsurface environment by mixing/dilution, sorption/desorption and degradation.

The potential for soil contamination is minor on a local scale. The sensitivity is low and the magnitude is medium adverse. A spill of fuel or oil would therefore potentially present a slight/not significant direct, short-term, negative effect on soil and subsoils along the proposed GCR and works area on the proposed TDR route.

Effects on Mineral/Aggregate Resources

The main effect of the proposed project with regard to mineral/aggregate resources is the removal of topsoil and excavation of the borrow pits. Soils on the proposed wind farm are generally shallow (<0.4m).

Excavated (non-peat) soils will be either reused locally alongside the proposed tracks on site, or used to reinstate the borrow pits. Any soil placed adjacent to the proposed tracks will be

restricted to use for drainage and contouring immediately adjacent to both sides of the proposed tracks (rather than stockpiling). All peat will be placed in the borrow pit areas. A spoil and peat management plan is included in Appendix 2-3.

Peaty topsoil and podzols are present on the proposed wind farm site at T1-T7. Gleys are present to the southern section of the proposed wind farm site. Due to the elevation of the site and the soil structure, the potential is limited for intensive agricultural land use.

The ground conditions generally consist of boulder clay overlying sandstone bedrock (Knockmealdown Sandstone Formation). It is proposed to utilise two borrow pits for the proposed project. The aggregate potential of the bedrock underlying the proposed project is classified as very high, which is an indication of the suitability of bedrock material.

The potential extraction of mineral/aggregate resources is limited and localised and therefore low sensitivity. There is no loss of mineral resources. The sensitivity is low and the magnitude is low adverse. There is anticipated to be a not significant, negative, certain, permanent effect on mineral and aggregate resources due to the relocation of material within the proposed wind farm.

Proposed GCR and works areas of the proposed TDR

There are no effects anticipated on mineral/aggregate resources along the proposed GCR or the works areas on the proposed TDR. There will be some movement of soils, subsoils and stone required for the construction of the proposed GCR and works area on the proposed TDR. The potential extraction of mineral/aggregate resources is very limited and localised and therefore low sensitivity. The sensitivity is low and the magnitude is negligible. Pre-mitigation potential effects on mineral and aggregate resources along the proposed GCR and the works areas on the proposed TDR are therefore considered to be imperceptible.

Effects on Soil Compaction and Erosion

The sensitivity of the underlying soils to soil compaction and erosion from the construction works is considered as low on a local scale due to the limited extent of peat onsite and shallow peat depths where present. Compaction and or erosion of soils can occur on construction sites. No significant depths of peat were encountered on the proposed wind farm site. Excavated material will arise from all infrastructure elements of the proposed wind farm (bases, access tracks, hardstanding etc.).

Table 8-7 below provides a summary of the excavation volumes necessary for infrastructure.

Table 8-7: Volume Summary

Area	Volume (m^3)
Hardstanding Foundations	50,600
Turbine Foundations	15,900
Substation and Compounds	7,400
Access Tracks	38,400
Total	112,300

Access tracks will be needed to accommodate the construction works and provide access to turbine locations for the life cycle of the proposed project. The access tracks will be constructed using borrow pit material as subbase and unbound crushed aggregates and they will incorporate drainage to maintain the performance of the pavement during wet weather. All access tracks will be constructed as founded roads. Founded roads are excavated down to and constructed up from a competent geological stratum. The access tracks will be constructed to average height of 0.3 m above existing ground level.

Some surfacing material will be imported from locally approved commercial quarries. The importing of material from external quarries will place additional pressure on transport routes, as discussed in Chapter 17 (Traffic and Transport).

As a part of the ground investigation, the material encountered at the trial pit locations consisted of shallow peaty soils (T1 to T7) underlain by reddish grey to light brown, soft to firm sandy tills. The soft peat conditions require removal for the wind turbine foundations. Deeper excavations to more competent material may be required to construct the turbine foundations. Based on the ground investigation, the proposed foundations will be gravity foundations. For gravity type turbine foundations, unsuitable material will be excavated and replaced by structural fill and excavated material will be placed in the deposition areas i.e. the borrow pits.

Due to the limited peat on site the sensitivity is low and the magnitude is low adverse. The potential effects on soils as a result of soil compaction and erosion are considered to be not significant, certain, permanent and negative.

<u>GCR and works areas of the proposed TDR</u>

The potential sensitivity of soil compaction and erosion is low and on a local scale for the GCR and works areas on the proposed TDR. There are limited off roads areas (<1ha) along the proposed GCR and works areas on the proposed TDR. No peat was encountered on the GCR or TDR. The sensitivity is low and the magnitude is low adverse. Pre-mitigation potential effects on soil compaction and erosion along the proposed GCR and the works areas on the proposed TDR are not significant, short term and reversible.

[not significant]Effects on Geohazards - Peat and Soil Stability

A planning stage Peat Stability Risk Assessment (PSRA) has been undertaken for the proposed project by Ciaran Reilly & Associates. The PSRA is included in Appendix 8-1.

The assessment has taken account of the shallow depths, drained, i.e. previously harvested areas. The stability analysis was completed with characteristic loads and soil strength parameters. The calculated over-design factor (ODF) must be greater than or equal to 1.0 for the design. The findings of the peat stability assessment showed that the proposed wind farm site has an acceptable ODF (3.2 or greater), is suitable for the proposed project development and is considered to be at low risk of peat failure. The sensitivity is considered high due to the presence of peaty soil and <1ha of peat (>0.5m) on the wind farm site. Due to the limited depth of peat and the PSRA results, the magnitude is low adverse. Potential effects are considered, slight/not significant, long term, negative, direct and indirect with very low probability.

GCR and works areas of the proposed TDR

No peat or karst is identified on the proposed GCR or works areas on the proposed TDR study area. There are no direct or indirect potential effects on areas of peat or karst.

8.5.3 Potential Effects – Operational Phase

Effects on Geological Heritage Sites

There are no geological heritage sites in the proposed wind farm site. There are no direct or indirect potential effects on Geological Heritage Sites.

Proposed GCR and works areas of the proposed TDR

There are no geological heritage sites along the proposed GCR and works area on the proposed TDR study area. There are no direct or indirect potential effects identified on Geological Heritage Sites.

Effects on Land Use

During the operational phase, there will be no land use change. The land use change is assessed during the construction phase. Where the footprint of the proposed infrastructure is not located and the associated felling is not required (i.e. on the vast majority of the proposed wind farm site) there will be no anticipated change in land use as those activities will continue. No significant land use changes will occur during the operational phase, therefore the sensitivity is considered low and the magnitude is considered negligible. Pre-mitigation potential effects on land use at the proposed wind farm site are considered imperceptible.

Proposed GCR and works areas of the proposed TDR

For the proposed GCR which is almost entirely located within public road corridors or else on private farms or forest tracks, there will be no significant change of land use (i.e. they will still be used for transport), although the land will also be used for electricity transmission. For a short section near the River Colligan GCR crossing, there will be permanent change of land use from agriculture and forestry to electricity transmission. The land use has a low value on a local scale

and the sensitivity is considered low. Due to the limited proportion along the GCR where a change of land use will occur and the magnitude is considered low adverse, it is anticipated that there will be a not significant effect on land use for the proposed GCR during the operational phase.

The works area on the proposed TDR will be reinstated at the end of the construction phase, so that the lands will revert to their original land uses of agriculture and transport respectively. The accommodation works (i.e. widening and passing bays) on the L5055 and L1029 local roads north of Affane Cross will be retained as permanent improvements. These are, however, located within the road corridor so the transportation land use will generally remain. The land use has a low value on a local scale and the sensitivity is considered low. Due to the limited proportion along the works areas on the proposed TDR where a change of land use will occur, the sensitivity is considered low and the magnitude is considered low adverse. It is therefore anticipated that the effect on land use at the works areas on the proposed TDR will be not significant and positive during the operational phase.

Effects on Contaminated Sites/ Potential for Contamination

Contaminated Sites

No contaminated sites were identified in the study area of the proposed project.

The sensitivity of the soils and subsoils is low and the magnitude is negligible. Pre-mitigation potential effects on previously contaminated sites are therefore considered to be imperceptible.

Potential for contamination

Any hydrocarbon or oil spills related to the maintenance of the proposed wind farm (access tracks, substation, turbines, etc.) has the potential to negatively affect the ground directly. The bunded transformers in the substation and in each turbine are oil cooled. There is potential for spills and leaks of oils from this equipment resulting in contamination of soils and subsoils.

Occasionally, machinery will access the proposed wind farm for maintenance of access tracks, substations and turbines. The presence of machinery on the proposed wind farm site has the potential to result in minor accidental leaks or spills of fuels/ oils contaminating the soils and subsoils.

The sensitivity of the soils and subsoils is medium and the magnitude is negligible. Pre-mitigation potential effects are therefore considered to be not significant due to the limited maintenance requirement and the proposed design standards applied i.e. bunding slight.

Proposed GCR and works areas of the proposed TDR

No significant works are required on the proposed GCR or works areas on the proposed TDR for the operational phase. Minor excavation of soils, subsoils and bedrock may be required where a grid fault is detected. These works will result in temporary disturbance of road surfaces and cable trenches/joint bays. Any surplus excavated material associated with the trench and access tracks will be removed off-site to a licenced facility. In addition, the cables do not contain hydrocarbons. The sensitivity is low and the magnitude is low adverse, the pre-mitigation

potential effects relating to contamination along the proposed GCR and works areas on the proposed TDR are considered not significant, unlikely, short term and negative.

Effects on Mineral/Aggregate Resources

The operational phase of the proposed project will not require movements of large amounts of stone materials. Therefore, it is not anticipated to cause a significant effect on any existing mineral or aggregate resources. In relation to indirect effects, small volumes of additional unbound crushed aggregate material may be required during the operational phase where roads/tracks have settled on the subsoil and to resurface unbound roads. Aggregates required will only be sourced from quarries which are listed on the register maintained by the local authority. This will place occasional demand on local stone resources. It is expected that only small quantities of unbound crushed aggregates may be needed.

There is no proposed extraction during the operational phase. The sensitivity is low and the magnitude is negligible adverse, the potential effects on mineral and aggregate resources at the proposed wind farm site are therefore considered to be imperceptible and long-term.

Proposed GCR and works areas of the proposed TDR

There are no anticipated operational phase effects associated with mineral/aggregate resources for the proposed GCR and the works areas on the proposed TDR.

Effects on Soil Compaction and Erosion

The sensitivity of the soils and subsoils during operation is low and the magnitude is negligible. The potential effects on soils as a result of soil compaction and erosion during operation are considered to be not significant, certain, permanent and negative.

Proposed GCR and works areas of the proposed TDR

There are no potential significant effects on the soils and subsoils as a result of soil compaction/erosion during the operational phase.

Effects on Geohazards - Peat and Soil Stability

A peat stability risk assessment (PSRA) sets out the methodology used to assess the peat stability risk, the activities undertaken, and the results of the peat stability assessment. There are no significant operational phase effects associated with geohazards for the proposed project. The PSRA is included in Appendix 8-1. The operational phase sensitivity is considered high due to the presence of peaty soils and peat, north of the wind farm site. As the sensitivity is high and the magnitude is negligible, there is potential for an imperceptible and long-term negative effects for geohazards (peat and soil stability).

Proposed GCR and works areas of the proposed TDR

There are no anticipated operational phase effects associated with geohazards for the proposed GCR and the works areas on the proposed TDR.

8.5.4 Potential Effects – Decommissioning

The potential effects associated with decommissioning will be similar to those associated with construction but of reduced magnitude because of limited excavations.

Turbine foundations and hardstands will remain in place underground and would be allowed to revegetate or reseed as appropriate. The proposed access tracks will remain in situ for forestry and agricultural access.

In most cases, and certainly for granular-based tracks (but also concrete and asphalt) these materials are inert and stable over the long-term, so will not pose a contamination risk if left in situ. The substation will be retained as a permanent structure and will not be decommissioned. The potential effects of the proposed project are summarised below.

Below ground infrastructure will remain in place during the decommissioning phase. The road improvements along the works areas on the proposed TDR will be left in situ, while the proposed GCR will not be decommissioned.

Effects on Geological Heritage Sites

There are no Geological Heritage Sites within the proposed project study area. No direct or indirect effects were identified on Geological Heritage Site features.

Effects on Land Use

The proposed wind farm site is predominantly covered in forestry and agricultural lands. There will be a change in land use associated with the proposed project. A total of 11 ha will be reinstated at the end of the decommissioning phase. The sensitivity on the wind farm site is low and the magnitude is low adverse. Therefore, the effect of the proposed project with regard to land use change, is considered not significant, negative, certain and long-term. There are no indirect effects anticipated on land use as a result of the proposed project.

Proposed GCR and works areas of the proposed TDR

There are no proposed works on the GCR or the works areas of the proposed TDR during the decommissioning phase.

Effects on Contaminated Sites/Potential for contamination

Contaminated sites

An evaluation was undertaken to determine the presence and extent of existing or potentially contaminated land in the proposed project study area. No contaminated sites were identified in the study area. The sensitivity of the soils and subsoils is low and the magnitude is negligible. Pre-mitigation potential effects on previously contaminated sites are therefore considered to be imperceptible. There are no indirect effects anticipated.

Potential for contamination

Decommissioning machinery and equipment which contain various vehicle fluids/oils and fuel have the potential to contaminate the site through leaks and/or spills. The proposed

infrastructure (including turbines, roads, substation and Decommissioning compounds) will be excavated and moved using excavators, wheeled dumpers, HGVs and bulldozers. Fuel will be required to supply the required machinery and the fuel will be stored at the decommissioning compounds. Potential leaks or spills from decommissioning activities within the proposed wind farm have the potential to pollute the soils and geology environment. The soils and subsoils on site are of low to moderate productivity. The sensitivity of the soils and subsoils is medium and the magnitude is medium adverse. Pre-mitigation potential effects are therefore considered to be slight, localised and short term on the potential for contaminating land at the proposed wind farm site.

Proposed GCR and works areas of the proposed TDR

There are no proposed works on the GCR or the works areas on the proposed TDR during the decommissioning phase.

Effects on Mineral/Aggregate Resources

There are no potential effects on mineral/aggregate resource during the decommissioning phase.

Effects on Soil Compaction and Erosion

The potential sensitivity of soil compaction and erosion is low on a local scale. Access tracks will remain in place. The sensitivity is low and the magnitude is low adverse. The potential effects on soil compaction and erosion are considered to be not significant, certain, permanent and negative.

Proposed GCR and works areas of the proposed TDR

The potential sensitivity of soil compaction and erosion is small on a local scale. There are limited off roads areas (< 1ha) along the proposed GCR and the proposed TDR. The sensitivity is low and the magnitude is low adverse. Pre-mitigation potential effects on soil compaction and erosion along the proposed GCR and the works areas on the proposed TDR are not significant, short term and reversible.

Effects on Geohazards - Peat and Soil Stability

Existing foundations and roads will remain in place following decommissioning. Potential effects are considered slight/not significant, long term, negative, direct and indirect, and very low probability.

Proposed GCR and works areas of the proposed TDR

No peat or karst is identified on the proposed GCR or the works areas on the proposed TDR study area. There are no proposed works on the proposed GCR or the works areas on the proposed TDR during the decommissioning phase.

8.6 MITIGATION MEASURES

Mitigation measures for the construction, operation and decommissioning of the proposed project, in order to avoid or reduce identified significant potential effects are described in the following sections. Standard design or embedded measures are included in Section 8.5.2. A Construction Environment Management Plan (CEMP) has been developed and can be viewed in Appendix 2.8.

8.6.1 Construction Phase

Mitigation - Geological Heritage Sites

No Geological Heritage Sites exist within the extent of the proposed project, and there are no direct or indirect potential significant effects. Therefore, no mitigation is required.

Mitigation - Land-Use

Based on the pre-mitigation level of effect (Not significant effect), additional mitigation is not required. The following measures however will be implemented.

Vegetation clearance will be kept to a minimum. The proposed construction work areas will be demarcated prior to the construction works commencing. No clearance of vegetation will be undertaken outside of the demarcated areas. Construction vehicles will be restricted to designated areas and access tracks in order to avoid impacting adjacent habitats and to ensure that soil compaction is restricted to these areas.

All disturbed ground outside of the permanent footprint will be fully reinstated following the completion of the works. Biodiversity enhancement measures will be undertaken to improve ecological habitats as detailed in Appendix 2-1.

Mitigation - Contaminated Sites/Potential for contamination

Based on the pre-mitigation level of effect (not significant effect), additional mitigation is not required. However, the following measures will be implemented.

Dedicated, bunded storage areas will be used for all fuels or hazardous substances. The earthworks will not be scheduled to be carried out during severe weather conditions. Good site practice will be applied to ensure that no fuels, oils, wastes or any other substances are stored in a manner on site in which they may spill and enter the ground.

Further information on good practice can be found in the CEMP (Appendix 2-8 of this EIAR) and the following measures will be implemented:

- Fuel storage and fuelling facilities will be required at several fixed locations and at mobile locations around the proposed project, given the size of the it is impractical to track large plant to a single fixed facility. Fuel storage and any oil storage will be carried out in accordance with the Enterprise Ireland Best Practice Guide BPGCS005 Oil Storage Guidelines.
- Fuel and oil storage at fixed locations will be in a fixed tank, undercover and within a steel or concrete bund.

- A dedicated impermeable bunded refuelling area will be constructed adjacent to the fixed fuel storage areas.
- Double skinned plastic tanks will not be acceptable for any purpose unless they are placed within fixed concrete or steel bunds.
- Each fixed fuel and oil storage bunds will be sized to hold 110 % of the volume of the largest tank therein. The rainwater pumped from each bund will be discharged to the surface water drainage system via an oil interceptor.
- In the event of a spill, the liquid contained in the bund will be removed by a liquid waste tanker, as will the contents of the surface water drainage system and oil interceptor. Where refuelling is required on site away from fixed storage locations, this will only be carried out utilising intrinsically bunded mobile steel fuel bowsers. At site refuelling locations, refuelling will take place within mobile bunds, but at a minimum the fuel line from the bowser to the plant being fuelled will be contained by drip trays.
- Generators and associated fuel tanks to be used will either be placed within bunds as per fuel storage tanks or will be integrated units (i.e., fuel tank and generator in one unit) that are intrinsically bunded. No external tanks and associated fuel lines will be permitted on site unless these are housed within a fixed bund with the generator.

The following measures will be implemented in terms of concrete/cement management:

- Contractors will be required to provide a designated bin for washing down the chutes of concrete lorries on site;
- Wash down and washout of concrete transporting vehicles will not take place on site. It is proposed to washout at the (offsite) source concrete batching site to prevent cementitious material and water entering the surface water network;
- Waste material will be removed from site to an appropriate waste permit facility; and
- Disposal of excess concrete on any part of the construction site will be prohibited.

The contractor's yard/maintenance yard will incorporate a bund for the storage of small items of plant and oil filled equipment, such as hand portable generators, pumps, etc. Storage of small volume oils or chemicals, in barrels, IBCs, etc, will be confined to a covered bunded area. Where barrels or other containers are required at work locations these will be stored in enclosed bunded cabinets, and drip trays will be used where distribution of the material is required.

The main storage areas for oil filled equipment, vehicles, plant, etc, will be on an impermeable surface and the discharge of surface water from these areas will be via oil interceptors. An oil spill response plan will be developed for the construction works and appropriate containment equipment will be available at work locations in the event of a spillage. Oil spill response will form part the induction and training of site personnel.

All wastes generated on site will be segregated and appropriate materials are re-used on site. Residual materials will be collected by licensed waste hauliers for appropriate sorting, recycling and disposal.

Mitigation - Mineral/Aggregate Resources

Based on the predicted level of effect, additional mitigation is not required. No significant effects were identified in Section 8.5.2 and therefore no additional mitigation measures are required.

Mitigation - Soil compaction and erosion

Based on the pre-mitigation level of effect (not significant effect), additional mitigation is not required. However, the following measures will be implemented.

Landscaping areas will be sealed and levelled using the back of an excavator bucket to minimise the potential for erosion. The upper vegetative layer will be stored with the vegetation part of the sod facing the right way up to encourage growth of plants and vegetation at the surface. to prevent erosion.

Peat, overburden, and rock will be reused on site to reinstate borrow pits and other excavations. Peat soils are limited and will be placed in the borrow pit deposition areas, completely below the existing ground profile on all sides thereby containing the peat/peaty soils and eliminating any possibility of a peat stability-related slope failure. The borrow pit deposition areas are located between T13 and T15 and provide an opportunity for landscaping and restoration to match the natural surroundings.

On completion, the borrow pit deposition area surfaces will be stabilised by the establishment of natural vegetation. The detailed design, construction, and operation and maintenance of the borrow pit backfill operation will be documented in the design stage Peat Stability Risk Assessment, the Peat Stability Risk Register, and the Site Geotechnical Folder which is to be handed over for operation and maintenance.

A key project goal is to incorporate sustainability into the design and construction of the project where practical. Where mineral soils are encountered in the excavation and construction of site roads, bases, etc, this material will be stockpiled for assessment and subsequent re-use. Where mineral soil is not directly suitable for construction it will be used for reinstatement works and will be geo-engineered as necessary.

As part of the proposed works two borrow pits are proposed to provide materials suitable for construction, the purpose of which is to minimise the need to import of aggregates from elsewhere, reducing the project's environmental footprint. It is not intended that the borrow pits be fully reinstated, although it is proposed that the borrow pits will be partially reinstated using suitable excess materials. The remaining borrow pit areas, post reinstatement, will be established to enhance biodiversity.

The construction traffic will utilise the permanent access track network for access and egress, and this access will be constructed in advance of other ground works in a sequential manner.

A Spoil and Peat Management Plan (SPMP) was developed as part of the planning application – See Appendix 2-3. This plan documents how spoil will be managed on site for re-use of materials, the design for on-site re-use and disposal options, and a scheme for the tracking and recording of soil movements. These measures will prevent the erosion of soil in the short and long term. Soils, overburden, and rock will be reused on site to reinstate any excavations where appropriate.

Access tracks will be constructed first to allow for access within the proposed project. Vehicular movements will be restricted to the footprint of the proposed project, particularly with respect to the newly constructed access tracks. This means that machinery must be kept to the tracks and aside from advancing excavations not move onto areas that are not permitted for the development, such as areas which have not been designated for access or infrastructure.

Construction of internal electricity transmission cables will present similar, but lower-level risks, to the construction risks outlined above, and the same mitigation measures will be adopted as above. Surplus material from the onsite roads will be reused on site in the borrow pits or on road upgrades.

P**roposed** GCR and works areas of the proposed TDR

Based on the pre-mitigation level of effect (not significant effect), additional mitigation is not required. The following measures however will be implemented.

The majority of the proposed GCR cabling will be laid in the public road. Construction method statements and templates will be implemented to ensure that the proposed GCR infrastructure is installed in accordance with the correct requirements, materials, and specifications of ESBN and EirGrid. The ducts will be installed and the trenches will be reinstated in accordance with ESBN/EirGrid, private third-party landowners and County Council specifications. Once all are satisfied, then the cables are pulled through the installed ducts in approximately 500 to 700 m sections.

Excavated mineral material will be temporarily stockpiled onsite for re-use during reinstatement. Stockpiles will be restricted to less than 2 m in height. Stockpiles will be located a minimum of 50 m from surface water features and all stockpiling locations will be subject to approval by the Site Manager and Project Ecological Clerk of Works (ECoW).

For concrete and asphalt/bitmac road sections, it is proposed to carry out immediate permanent reinstatement in accordance with the specification and to the approval of the local authority and/or private landowners, unless otherwise agreed with the local authority. Surplus excavated bitmac material will be brought to a recycling facility for processing in accordance with the circular economy approach.

For offroad i.e access tracks/grass sections, the cable section will be laid within an existing access track. Silt fences will be utilised along the offroad sections. Short sections (<50m) will be excavated and reinstated on a phased basis with suitable excavated material to ground level and finish in a gravel track as per the EirGrid/ESBN specification. By limiting the excavated sections, the potential for compact or erosion is limited.

Mitigation - Geohazard/Peat and Soil Stability

Based on the pre-mitigation level of effect (not significant effect), additional mitigation is not required. The following measures however will be implemented.

Peat or peaty soils on the proposed wind farm are shallow. Given the scale of the project, a major consideration for its development is the management of the materials excavated as part of the construction works. To this end and in order to further mitigate against any risk of peat instability, it is proposed to use any excavated peat to backfill the extant borrow pit areas. A Spoil and Peat Management Plan is provided in Appendix 2-3. A full material management plan for the various phases of the development will be designed and maintained over the course of the project.

Mitigation measures include stepping or battering back of excavations to a safe angle to support the peat and soft clays during construction. To ensure slope stability, excavations will be battered back (sloped) to between 1:1.5 and 1:2 depending on the depth and type of material.

Permanent slopes will generally be less than 1:3. The works programme for the construction stage of the proposed project will also take account of weather forecasts and predicted rainfall in particular. Large excavations and movements of subsoil or vegetation stripping will be suspended or scaled back if heavy rain is forecast. Works will be suspended if the forecast suggests any of the following is likely to occur:

- >10 mm/hr rainfall (i.e., high intensity local rainfall events);
- >25 mm rainfall in a 24-hour period (heavy frontal rainfall lasting most of the day); or
- >Half the monthly average rainfall in any 7 days.

Prior to works being suspended the following control measures will be completed:

- All open excavations to be secured;
- Temporary or emergency drainage to be provided to prevent back-up of surface runoff; and
- Work during heavy rainfall and for up to 24 hours after heavy rainfall events to be suspended to ensure that drainage systems are not overloaded.

Following mitigation, the hazard ranking of the development is considered to be "low" for all areas. It is concluded that the proposed wind farm site, works areas on the proposed TDR and proposed GCR is suitable for the proposed project.

The management of peat stability will be ongoing throughout the construction and operational stages of the project and will be managed through the use of a geotechnical risk register. Following application of mitigation measures, including consideration to the siting of infrastructure to minimise the risk, the findings of the planning stage PSRA indicate a *"low"* to *"negligible"* hazard ranking for instability related to the requirement for excavations on the proposed project subject to appropriate mitigation measures.

Construction of Turbine 6 was highlighted as *"high"* landslide susceptibility risk based on desktop information. However, local deterministic risk assessments have classified the risk to what would be considered *"low"*. This is due to the relatively shallow depths of peat encountered during ground investigations (0.2 to 0.4m).

Deterministic stability assessments indicate that the materials are considered to be stable in the short (undrained) and long (drained) term, including under the influence of extreme weather events, hence justifying the *"low"* to *"negligible"* hazard rankings assigned.

A physical barrier will be implemented between the excavations and the potentially unstable material at unstable conditions, in the form of a granular berm or sheet piles. The long-term stability of the area around the wind turbine foundations will be achieved by filling the area back up to existing ground level following installation of the foundation.

A suitably qualified and experienced geotechnical engineer or engineering geologist will monitor excavation works. The earthworks will not be carried out during severe weather conditions.

<u>Proposed GCR and works areas of the proposed TDR</u>

Based on the predicted level of effect, additional mitigation is not required.

8.6.2 Operational Phase

Operational activities at the proposed project will focus on the maintenance of wind turbines and associated infrastructure. Oil containing components of the wind turbines will be periodically refurbished and replaced.

Mitigation - Geological Heritage Sites

No Geological Heritage Sites exist within the proposed project study area, therefore no mitigation is required.

Mitigation - Land Use

Based on the predicted level of effect, additional mitigation is not required.

Mitigation - Contamination

Fuel and oil storage and handling requirements will be as detailed for construction, with permanent fuel and oil storage located within permanent covered bunds.

Electrical apparatus, such as transformers, will be required within the substations. All such oil containing electrical apparatus will be placed within permanent concrete bunds that will have been constructed and tested to provide containment. Each bund will be sized to hold 110 % of the oil volume within the respective electrical apparatus enclosed. The bunds will be bunded and alarmed to allow for the regular removal of clean rainwater by means of a pump. In the event of a spill, the liquid contained in the bund will be removed by liquid waste tanker, as will be the contents of the surface water drainage system and oil interceptor.

Surface water discharges from permanent storage areas and substation bunds will be to surface water via an oil interceptor. The oil interceptors at the proposed project will be subject to a regular inspection and de-sludging to ensure that they retain full operational efficiency.

Site operatives will receive appropriate training and materials will be available on site to immediately respond to any fuel or oil spill.

Welfare facilities will be provided at the substation location. These welfare facilities will produce foul effluent and these effluents will be stored in a holding tank prior to removal to an approved treatment facility.

Mitigation - Mineral/Aggregate Resources

Based on the predicted level of effect, additional mitigation is not required. No significant direct or indirect effects were identified in Section 8.5.3 and therefore no additional mitigation measures are required.

Mitigation - Soil Compaction and Erosion

Based on the predicted level of effect, additional mitigation is not required. No significant direct or indirect effects were identified in Section 8.5.3 and therefore no additional mitigation measures are required.

Mitigation - Geohazard /Peat and Soil stability

No significant effects were identified in Section 8.5.3 and therefore no additional mitigation measures are required. The following outlines an overview of the tasks for the operation and maintenance phase:

- Communication of residual peat risk to appropriate site operatives;
- Ongoing monitoring of residual risks and maintenance if required.

Monitoring will consist of regular inspection of drains to prevent blockages and inspections of specific areas after a significant rainfall events.

8.6.3 Decommissioning Phase

No significant potential effects were identified for the decommissioning phase.

A fuel management plan to avoid contamination by fuel leakage during decommissioning works will be implemented as per the construction phase mitigation measures.

The risks arising from the decommissioning of the proposed project would be less than those for construction. Mitigation measures for decommissioning would conform to those given for construction (section 8.6.1) and would be anticipated to be fully protective of the environment.

Proposed GCR and works areas of the proposed TDR

There are no works proposed in relation to decommissioning phase works for the proposed GCR or on the works areas of the proposed TDR.

8.7 RESIDUAL EFFECTS

The replacement of natural soil, subsoils, and rock with gravels and concrete for the construction of the infrastructure (temporary and permanent) will result in a change in ground conditions within the proposed wind farm site. Overall, due the relatively low sensitivity of the Land, Soils and Geology conditions locally and the implementation of the mitigation measures above, the residual effect is not significant and neither permanent nor negative as summarised in Table 8-8 to 8-13 below.

Following mitigation measures, the residual effect in relation to peat stability will be not significant, short-term, negative and will be localised to excavations carried out during the construction, operational and decommissioning phases.

All other potential effects on the land, soil and geological environment will be mitigated through good site practice, reduced vehicular movements and the sustainable use of natural resources, as discussed previously.

Table 8-8: Summary of post-mitigation effects on the receiving environment during the construction phase

Environmental Attribute	Residual Effects– Construction
Geological heritage sites	None as no geological heritage site within the proposed project study area.
Land Use	Temporary long term loss of soils –Not Significant, direct effects
Contaminated sites/Potential for contamination	Slight/not significant, localised, short term
Mineral/Aggregate Resources	Imperceptible, long term effect
Soil Compaction and erosion	The potential effect on land soils and geology is negative, certain, direct, not significant and long term.
Geohazards/Peat and Soil Stability	No karst feature. Peat and soft sediments present and assessed via PSRA. Potential effects are long term, negative, not significant, direct and indirect, very low probability.

Table 8-9: Summary of post-mitigation effects – GCR and TDR during the construction phase

Environmental Attribute	Residual Effect– Construction
Geological heritage sites	None as no geological heritage site within the proposed project study area.
Land Use	Temporary loss of soils – imperceptible, direct, temporary effects
Contaminated sites/Potential for contamination	Slight/ not significant, localised, short term
Mineral/Aggregate Resources	Imperceptible, long term effect
Soil Compaction and erosion	Not significant, short term.
Geohazards/Peat and Soil Stability	No karst features. No peat identified. No residual effects.

Table 8-10: Summary of post-mitigation effects on the receiving environment during the operational phase

Environmental Attribute	Residual Effect – Operational
Geological heritage sites	None as no geological heritage site within the proposed project study area.
Land Use	Imperceptible, certain, direct and long term.
Contaminated sites/Potential for contamination	Imperceptible, certain, direct and long term.
Mineral/Aggregate Resources	Imperceptible, certain, direct and long term.
Soil Compaction and erosion	Not significant, certain, permanent and negative.
Geohazards/Peat and Soil Stability	Long term, negative, imperceptible, direct and indirect, very low probability.

Table 8-11: Summary of post-mitigation effects – GCR and TDR during the operational phase

Environmental Attribute	Residual Effect – Operational
Geological heritage sites	None as no geological heritage site within the proposed project study area.
Land Use	Imperceptible, certain, direct and long term.
Contaminated sites/Potential for contamination	Imperceptible, certain, direct and long term.
Mineral/Aggregate Resources	No residual effects.
Soil Compaction and erosion	No residual effects.
Geohazards/Peat and Soil Stability	No karst feature, No peat. No residual effects.

Table 8-12: Summary of post-mitigation effects on the receiving environment during the decommissioning phase

Environmental Attribute	Residual Effect –Decommissioning
Geological heritage sites	None as no geological heritage site within the proposed project study area.
Land Use	Imperceptible, certain, direct and long term.
Contaminated sites/Potential for contamination	Not significant, certain, direct and long term.
Mineral/Aggregate Resources	Imperceptible, certain, direct and long term.
Soil Compaction and erosion	Imperceptible, certain, direct and long term.
Geohazards/Peat and Soil Stability	Long term, negative, imperceptible, very low probability.

Table 8-13: Summary of post-mitigation effects –during the decommissioning phase - GCR and TDR

Environmental Attribute	Residual Effect –Decommissioning
Geological heritage sites	None as no geological heritage site within the proposed project study area.
Land Use	Imperceptible, certain, direct and long term.
Contaminated sites/Potential for contamination	Imperceptible, certain, direct and long term.
Mineral/Aggregate Resources	Imperceptible, certain, direct and long term.
Soil Compaction and erosion	Imperceptible, certain, direct and long term.
Geohazards/Peat and Soil Stability	No karst feature, No peat No residual effects.

8.7.1 CUMULATIVE EFFECTS

Cumulative effects of this project with other developments in the region, are discussed here, with reference to Chapter 4 - Policy, Planning and Development Context.

The developments include other existing, planned or proposed developments in the environs of the proposed project and/or developments with the potential to interface with the project in terms of environmental effects. Developments were identified within 5 km of the proposed wind farm site and within 200m of the proposed GCR and the proposed TDR works areas are detailed below.

The location of any offsite replanting (alternative afforestation) associated with the project will be greater than 10km from the proposed wind farm site. This was also considered here, but was found to have no significant cumulative effects due to this location requirement.

Wind Farms

- **Coumnagappul Wind Farm ABP Ref. 318446 -**The proposed development area of Coumnagappul Wind Farm is located 16 km North of Dungarvan. The wind farm site comprises a 110kV substation and is expected to connect to the 110kV Dungarvan substation via an underground cable. A decision is due on this application.
- **Dyrick Hill Wind Farm ABP Ref. 317265 –** The proposed development is located to the east of the proposed development and comprises the construction of Dyrick Hill Wind Farm comprising 12 wind turbines and related works, located within the townlands of Ballymacmague North, Ballymacmague South, Ballynaguilkee Lower, Ballynaguilkee

Upper, Broemoutain, Carrigaun (Mansfield) and others, Co. Waterford. This application was refused by Waterford County Council and is appealed to An Bord Pleanala.

Grid Connections

- **ABP Ref. 311670** – An application for a 10kV underground grid connection infrastructure on the N27 road to connect a Solar Farm to an ESB Substation, accompanied by a Natura Impact Statement, was granted approval with conditions on 09/01/2023. The permitted development is located within Killadangan, Ballymacmaque Sth, Ballymacmague Nth, Ballylemon Lwr, Knockacullen, Killeeshal, Ballynamintra Upr, Cappagh, Kilcannon (Osbourne), Kilcannon (Hely), Ballynahemery, Rockfield, Bawnavinnoge, Kilcoher, Boherawillin, Drumroe, Cappoquin, Co. Waterford.
- **ABP Ref. 306497** – A proposed wind farm Grid Connection, accompanied by an EIAR, was granted with conditions on 18/02/2021. The permitted development is located in Keereen Upper/Woodhouse or, Tinakilly/Knocknamona Townlands, Dungarvan, Co. Waterford.

Solar Farms

- **Waterford Reg. Ref.- 17/564 (ABP Ref. 300004)**–A 10-year permission for construction of Solar PV Energy development, substation, transformer, solar panels and all associated infrastructure and site works was granted with conditions on 19/02/2019. The permitted development is located in Ballyard, Ballyhane & Clashnagoneen, Cappoquin Co. Waterford.
- **Waterford Reg. Ref. 16/126 (ABP Ref 246902)** – A 10-year permission for construction of a solar PV energy development within a total site area of 28.8 Ha and all ancillary site development works was granted with revised conditions on 15/11/2016. The permitted development is located in Drumroe, Cappoquin, Co. Waterford.
- **Waterford Reg. Ref. -18598 (ABP Ref. 303576)** A proposed Solar Farm at Poulbautia, Cappoquin County Waterford was granted with conditions on 28/05/2019.

Other Developments

- A review of the Waterford City & County Council planning portal revealed a number of small scale residential and rural developments (e.g., residential one-off housing and agriculturally based developments) proposed in areas between Cappoquin, Ballynamult and Knocknafallia in proximity to the proposed project. Considering the small scale residential and rural developments, there is no potential for significant negative effects on Land Soils and Geology. A full list of planning applications within the wider area of the proposed project is provided in Chapter 5 (Policy, Planning & Development Context) Appendix 5-1 of this EIAR.

8.7.2 Assessment of Cumulative Effects

Based on a review of the locations and limited potential for interactions in terms of land, soils and geology, Dyrick Hill (ABP Ref. 317265) is the only project with potential cumulative effects and these are considered further below. Based on a review of the solar farm applications, limited excavations are required and do not physically overlap with the currently proposed project works.

Dyrick Wind Farm

Dyrick Wind Farm (An Bord Pleanála Reference: 317265) comprised of 12 wind turbines and associated works, is located approximately 150 metres from the proposed project. Each turbine will have a maximum overall height of 185 metres. It was applied for in 2023. No peat was encountered on the site. The proposed wind farm, if granted, will be completed in 2025, prior to the construction of the proposed project An EIAR for this development concluded that, with the implementation of appropriate mitigation measures, the proposed wind farm at Dyrick Hill will have no potential for cumulative effects with other known projects. No peat was encountered on the Dyrick Hill Wind Farm site and there is no overlap with the proposed wind farm site. Based on a review of the effects for the proposed project and a review of the potential effects Dyrick Hill Wind Farm, there are no potential significant cumulative effects.

Conclusion on Cumulative Impact Assessment

No significant cumulative effects on land, soils and geology have been identified from Dyrick Hill wind farm or other plans and projects. No significant cumulative or residual effects were reported for Land, Soils and Geology receptors within any of the nearby wind farm/other assessment reviewed. Taking into consideration other plans and projects no residual cumulative effects are anticipated.

Due to the localised nature of the proposed works within the proposed project boundary, there is no potential for significant, negative cumulative effects in-combination with other local developments on the land, soils and geology environment.

8.8 SUMMARY

The proposed project is located in an upland area with limited peat soils underlain by glacial soils that in turn overly sandstones. No significant geological resources are known at the proposed project and there are no geological heritage sites within the proposed project.

Peat is limited on the proposed project. Due to the relatively drained and cutaway nature of the peaty soils/peat, peat stability risk is limited to localised construction areas at the proposed project.

The principal risks associated with land, soil and geology at the proposed project are the management of soils. It is expected that these risks will be fully mitigated through the implementation of the identified mitigation measures.

Hence, it is not expected that the proposed project will give rise to any significant residual or cumulative effects with regard to land, soils and geology.

References

- Aerial Photographs (Geological Survey Ireland / Ordnance Survey of Ireland); (accessed Apr 2024)
- Atlas of Ireland (Royal Irish Academy);
- CIRIA (2006) C648 Control of water pollution from linear construction project guidelines
- CIRIA (2015) C741 Environmental good practice on site
- Environment Agency for England and Wales 'Pollution Prevention Guideline (PPG6) Working at Construction and Demolition Sites' , and
- Environmental Protection Agency and Geological Survey Ireland (2009). Historic Mine Sites - Inventory and Risk Classification;
- Environment Agency, UK (2020) Land Contamination Risk Management (LCRM);
- Fealy, R. M., Green, S., Loftus, M., Meehan, R., Radford, T., Cronin, C. and Bulfin, M. 2009. Teagasc EPA Soil and Subsoils Mapping Project-Final Report. Volume I. Teagasc. Dublin.
- Geological Survey Ireland (2001). 1:100,000 scale Sheet No. 20;
- Geological Survey Ireland (2012). Geological heritage of Waterford (accessed Apr 2024)
- Historical Geological 6 inch:1mile maps; (accessed Apr 2024)
- Historic Mine Sites – Inventory and Risk Classification (EPA & GSI); (accessed Apr 2024)
- Historical OSI 6" and 25" maps; (accessed Apr 2024)
- Local Authorities (Waste Management Section);
- Local Authorities (County Development Plans); (accessed Apr 2024)
- McCabe, A.M., 2008. Glacial Geology and geomorphology: The Landscapes of Ireland.
- Mitchell, F., 2009. The Holocene. In: Holland, C.H. and Sanders, I.H. (Editors) The Geology of Ireland;
- Mitchell, F. and Delaney, C., 1997. The Quaternary of the Irish Midlands. Irish Association for Quaternary Studies (IQUA) Field Guide Number 21;
- Mitchell, G.F. and Ryan, M., 1998. Reading the Irish Landscape;
- OSI 1:50,000 scale maps, Sheets 35, 42, 43, 49 and 50;
- Rudland, D.J., Lancefield, R.M. and Mayell, P.N. (2011). Contaminated Land Risk Assessment, A Guide to Good Practice. CIRIA C552 London;