FEHILY TIMONEY

DESIGNING AND DELIVERING
A SUSTAINABLE FUTURE

ENVIRONMENTAL IMPACT ASSESSMENT REPORT (EIAR) FOR THE PROPOSED DREHID WIND FARM AND SUBSTATION, CO. KILDARE

VOLUME 2 – MAIN EIAR

CHAPTER 9 – SOILS, GEOLOGY AND HYDROGEOLOGY

Prepared for:

North Kildare Wind Fram Ltd

Date: **May 2025**

Unit 3/4, Northwood House, Northwood Crescent,
Northwood, Dublin, D09 X899, Ireland

T: +353 1 658 3500 | E: info@ftco.ie

CORK | DUBLIN | CARLOW

www.fehilytimoney.ie

TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF FIGURES

LIST OF TABLES

9. SOILS, GEOLOGY & HYDROGEOOGY

9.1. Introduction

This chapter has been prepared to examine the potential impacts of the Proposed Development on existing geological and hydrogeological conditions within the Proposed Development study area. The effects of the Proposed Development are considered, taking account of mitigation measures to reduce or eliminate any residual impacts on soils, geology & hydrogeology. The assessment also considers the cumulative impacts associated with other nearby developments.

A detailed description of the Proposed Development assessed in this EIAR is provided in Chapter 3. In summary, the Proposed Project for EIA purposes is made up of the Proposed Development which includes the Proposed Wind Farm (including the Turbine Delivery Route) and the Proposed Substation.

The Proposed Wind Farm includes 11 wind turbines, internal access tracks, hard standings, internal electrical and communications cabling, temporary construction compounds, drainage infrastructure and all associated works related to the construction of the Proposed Wind Farm. The Proposed Wind Farm also includes the 'Proposed Recreation and Amenity Trail'. For a full description of the Proposed Wind Farm please see Chapter 3 of this EIAR.

The Proposed Substation includes the proposed 110 kV substation and a loop-in/loop-out connection to the existing 110 kV Kinnegard-Rinawade overhead line. For a full description of the Proposed Substation please see Chapter 3 of this EIAR.

9.2. Methodology

In summary the methodology adopted for this assessment includes:

- Review of appropriate guidance and legislation;
- Characterization of the receiving environment;
- Review of the Proposed Development;
- Assessment of potential effects;
- Identification of mitigation measures; and
- Assessment of residual impacts.

The assessment methodology and criteria are outlined in Section 9.2.3.

9.2.1. Relevant Guidance

The general EIA guidelines are listed in Chapter 1, other topic specific reference documents used in the preparation of this section include the following:

- NRA (2009), Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;
- IGI (2013), Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements;
- Scottish Executive (2017) Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments, 2nd Edition;
- European Union (2000/60/EC) Water Framework Directive;
- European Union (2006/188/EC) Groundwater Directive;
- Government of Ireland (2010) European Communities Environmental Objectives (Groundwater) Regulations (S.I. No. 9 of 2010);
- Government of Ireland (2003) European Communities (Water Policy) Regulations (S.I. No. 722 of 2003);
- EPA (2003), Towards Setting Guideline Values for the Protection of Groundwater in Ireland.
- EPA (2022), Guidelines on the Information to be Contained in Environmental Impact Assessment Reports.
- Water Framework Directive (WFD) provides for the protection, improvement and sustainable use of waters, including rivers, lakes, coastal waters, estuaries and groundwater within the EU Member States.
- DoEHLG Wind Farm Planning Guidelines
- IWEA Best Practice Guidelines

9.2.2. Impact Appraisal Methodology

As outlined in Section 9.2.3, Table 9-1, the aim of this is to identify the impacts of the construction, operation and decommissioning of the Proposed Development and associated works on the existing Soils, Geology and Hydrogeology of the study area. The assessment also identifies appropriate mitigation measures to minimize these impacts.

The following elements were examined to determine the potential impacts of the Proposed Development on the Soils, Geology and Hydrogeology within the study area:

- Characterization of the soils, geology and hydrogeology underlying the Proposed Development;
- Evaluation of the potential impacts of the Proposed Development.

The baseline geological and hydrogeological conditions within the study area were determined following a desktop review of publicly available information including aerial photography and EPA and GSI online databases. Several site walkovers were also carried out as listed below:

- 31-07-2018 and 01-08-2018: The northern turbines were peat probed, including T7, T8, T09, T10, T11, also some areas between T8 and T9 (superseded access track location), Proposed Substation (superseded location), and one point near T7 location (due to accessibility limitations);
- 24-02-2023: Peat testing at Proposed Substation (superseded location);
- 27-10-2023: Peat testing at Proposed Substation (current proposed location);
- 23-01-2024 and 26-01-2024: General walkover and peat testing for updated alignments and turbine locations, excluding Coillte area;
- 30-09-2024: General walkover and peat testing carried out for the area in Coillte ownership and the revised access road alignment at the northern entrance for oversized turbine components delivery , and at the secondary site access from public road entrance to T4/T5.

The study area is defined as the area that could potentially experience impacts from any element of the Proposed Development.

Following the assessment of the existing environment, the unmitigated impacts of the Proposed Development during the construction, operational and decommissioning phases on sensitive receptors identified were determined. The evaluation of the significance of the impacts was undertaken in accordance with the IGI guidance (2013).

Where potential impacts were identified, mitigation measures were recommended to minimize impacts on the environment to acceptable levels of significance.

The residual impact from the Proposed Development was then re-appraised taking into account the recommended measures. The residual impacts from the Proposed Development are presented in Section 9.7.

9.2.3. Evaluation Criteria

During each phase (construction, operation, maintenance and decommissioning) of the Proposed Development, several activities will take place on site, some of which will have the potential to cause impacts on the geological regime at the Proposed Development site and the associated Soils, Geology & Hydrogeology. These potential impacts are discussed throughout this chapter. Mitigation measures where required, are presented in Section 9.6.

9.2.4. Assessment of Magnitude and Significance of Impact on Soils, Geology & Hydrogeology

An impact rating has been developed for each of the phases of the Proposed Development based on the Institute for Geologists Ireland (IGI) “Guidance for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements”. In line with the IGI Guidance, the receiving environment (Geological Features) was first identified.

Using the NRA rating criteria in Appendix C of the IGI Guidance, the importance of the geological and hydrogeological features are rated (Table 9-1 and Table 9-2) followed by an estimation of the magnitude of the impacts on geological and hydrogeological features (and Table 9-4).

This determines the significance of the impact prior to application of mitigation measures as set out in Table 9-1.

Table 9-1: Criteria rating Site Importance of Geological Features (NRA, 2009)

Magnitude	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 the site is significant on a national or regional scale.	• Geological feature 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 the site is significant on a local scale.	• Contaminated soil on site with previous heavy industrial usage; • Large recent landfill site for mixed wastes; • Geological feature of high value on a local scale (County Geological Site); • Well drained and/or 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 the 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 the site is small on a local scale.	• Large historical and/or recent site for construction and demolition wastes; • Small historical and/or recent landfill site for construction and demolition wastes; • Poorly drained and/or low fertility soils; • Uneconomic extractable mineral resource.

Table 9-2: Criteria rating Site Importance of Hydrogeological Features (NRA, 2009)

Importance	Criteria	Typical Example
Extremely High	Attribute has a high quality or value on an international scale.	Groundwater supports river, wetland or surface water body ecosystem protected by EU legislation e.g. SAC or SPA status
Very High	Attribute has a high quality or value on a regional or national scale.	Regionally Important Aquifer with multiple wellfields. Groundwater supports river, wetland or surface water body ecosystem protected by national legislation – e.g. NHA status. Regionally important potable water source supplying >2500 homes Inner source protection area for regionally important water source.
High	Attribute has a high quality or value on a local scale.	Regionally Important Aquifer. Groundwater provides large proportion of baseflow to local rivers. Locally important potable water source supplying >1000 homes. Outer source protection area for regionally important water source. Inner source protection area for locally important water source.
Medium	Attribute has a medium quality or value on a local scale.	Locally Important Aquifer Potable water source supplying >50 homes. Outer source protection area for locally important water source.
Low	Attribute has a low quality or value on a local scale.	Poor Bedrock Aquifer. Potable water source supplying <50 homes.

The assessment of the magnitude of an impact incorporates the timing, scale, size and duration of the potential impact. The magnitude criteria for impact on Geological and Hydrogeological features are outlined in Table 9-3 and Table 9-4 respectively.

Table 9-3: Estimation of Magnitude of Impact on Geological Features (NRA, 2009)

Magnitude	Criteria	Typical Example
Large 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
Moderate 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
Small 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

Magnitude	Criteria	Typical Example
		• 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 use or integrity	No measurable changes in attributes
Minor Beneficial	Results in minor improvement of attribute quality	Minor enhancement of geological heritage feature
Moderate Beneficial	Results in moderate improvement of attribute quality	Moderate enhancement of geological heritage feature
Major Beneficial	Results in major improvement of attribute quality	Major enhancement of geological heritage feature

Table 9-4: Estimation of Magnitude of Impact on Hydrogeological Features (NRA, 2009)

Magnitude	Criteria	Typical Example
Large Adverse	Results in loss of attribute and /or quality and integrity of attribute	Removal of large proportion of aquifer. Changes to aquifer or unsaturated zone resulting in extensive change to existing water supply wells, river baseflow or ecosystems. Potential high risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >2% annually.
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Removal of moderate proportion of aquifer. Changes to aquifer or unsaturated zone resulting in moderate change to existing water supply wells, river baseflow or ecosystems. Potential medium risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >1% annually.

Magnitude	Criteria	Typical Example
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	Removal of small proportion of aquifer. Changes to aquifer or unsaturated zone resulting in minor change to water supply wells, river baseflow or ecosystems. Potential low risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >0.5% annually.
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	Calculated risk of serious pollution incident <0.5% annually.

The matrix in Table 9-5 determines the significance of the impacts based on the importance and magnitude of the impacts as determined by Table 9-1 to Table 9-4.

Table 9-5: Ratings of Significance of Impacts for Geology/Hydrogeology (NRA, 2009)

Importance of Attribute	Magnitude of Impact			
	Negligible	Small Adverse	Moderate Adverse	Large Adverse
Extremely High	Imperceptible	Significant	Profound	Profound
Very High	Imperceptible	Significant/Moderate	Profound/Significant	Profound
High	Imperceptible	Moderate/Slight	Significant/Moderate	Profound/Significant
Medium	Imperceptible	Slight	Moderate	Significant
Low	Imperceptible	Imperceptible	Slight	Slight/Moderate

The determination of the significance of each impact for the Proposed Development is discussed in Section 9.4.

9.2.5. Desk Study - Methodology

Prior to undertaking the site walkovers, a desk study was undertaken to determine the baseline conditions within the study area and planning boundary to provide relevant background information. The desk top study involved an examination of the following sources of information:

- IGI (2013). Geology in Environmental Impact Statements. Institute of Geologists of Ireland [1]
- Sleeman, A.G. & Pracht, M. (1994) 'Geology of Kildare-Wicklow Sheet 16 Book & Map. Description of the Bedrock Geology 1:500,000 Scale Map Series, Sheet 16, Kildare-Wicklow' [2]
- Kildare County Development Plan 2023-2029 [3]
- County Kildare Groundwater Protection Scheme, 2002 [4]
- Aerial imagery from Google and Bing accessed in 2024 [5]
- Current and historical (6 inch and 25 inch) Ordnance Survey maps and aerial imagery [6]
- DoEHLG Wind Farm Planning Guidelines [7]
- IWEA Best Practice Guidelines [8]
- Flood Risk Data [9]
- Ecological Designations [10]
- Mapping data of the area produced by the Geological Survey of Ireland (GSI) [11]
    - Quaternary subsoil geology;
    - 100k bedrock geology;
    - Karst features;
    - Geological heritage features;
    - Aggregate potential;
    - Landslide susceptibility;
    - Physiographic Units;
- Datasets from the EPA [12]
- European Union open datasets [13]
- Peat Landslide Hazard and Risk Assessments, Best Practice Guide for Proposed Electricity Generation Developments [14]
- Taluntais, F. (1980). The General Soil Map of Ireland, second edition. National Soil Survey of Ireland [15]

9.2.6. Site Investigations and Field Assessments – Methodology

As part of the geotechnical assessment, walkovers were undertaken by Fehily Timoney and Company (FT) for the Proposed Substation in October 2023; for the Proposed Wind Farm in July and August 2018, and in January and September in 2024 to determine the baseline characteristics of the Proposed Development site.

The site assessment works undertaken comprised the following:

- Walkover inspections of the Proposed Development site with recording of salient geomorphological features at proposed infrastructure locations;
- Peat depth probing and slope stability assessment at proposed infrastructure locations and where peat deposits were encountered;
- Recording of GPS co-ordinates of site investigation locations using a hand-held GPS.

9.3. Receiving Environment

9.3.1. General

The Proposed Wind Farm site includes lands in the townlands of Ballynamullagh, Kilmurry, Killyon, Coolree, Mulgeeth, Drehid and Dunfierth. The Proposed Substation, including the loop-in connection to the existing Kinnegad-Rinawade overhead line, is wholly located in County Kildare, within the townland of Coolree. The site of the Proposed Development is accessed from the M4 motorway from Enfield, then along the R402 for c. 7.7km and finally along the local road (L5025) to the main entrance of the site. The site lies c. 2.8km south of the motorway M4 at Enfield and 1.2km southeast of the regional road R402 linking the M4 to the R420 east of Tullamore in County Offaly. The Proposed Development site is 79 ha in size.

The site of the Proposed Development is located in relatively low-lying but undulating land with the majority of proposed turbines located beneath the 82m contour line. The landcover is classified in the Corine database as 2.3.1 Pastures; 3.1.2 Coniferous Forest and 3.2.4 Transitional Woodland shrub. The Corine land cover for the Proposed Wind Farm site is illustrated in Chapter 3, Description of Proposed Development. The east of the site is adjacent to a cutover bog (Timahoe Bog). The Fear English River passes through the site and travels along its western boundary.

The existing environment is described hereunder. This includes descriptions of the underlying Quaternary and bedrock geology, areas of geological heritage, areas of economic interest with respect to geological resources, potential for soil contamination, aquifer classification, groundwater vulnerability and groundwater wells. This section also includes a summary of site-specific information obtained during site walkovers undertaken as part of the baseline assessment works.

9.3.2. Quaternary Geology

GSI 1:50,000 Quaternary Subsoil mapping (Figure 9-1) indicates the Proposed Development site is partly located along the western side of Mulgeeth bog and on the north of Drehid bog. Therefore, shallow to moderately deep bodies of peat are expected to the north of turbines T6 and T7 as confirmed through the previous peat probing campaigns (see Section 9.3.5, Table 9-9).

Underlying gravel deposits derived from limestones are limited to the peat bog along the northern area of the Proposed Development.

Till derived from limestones is underlying the peat bog and the gravel deposits. It also outcrops to the eastern limit of the peat bog and along the southern area of the Proposed Wind Farm.

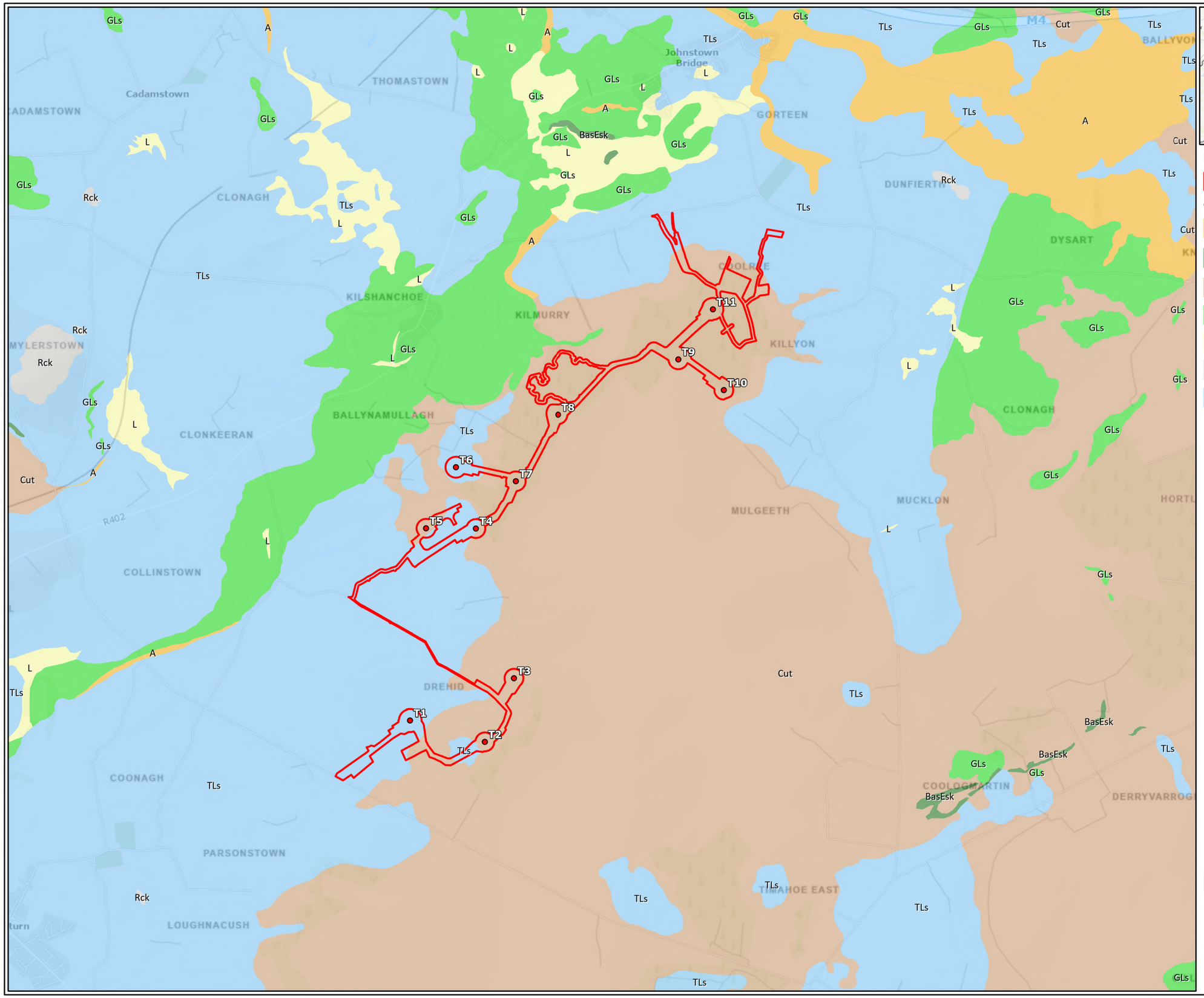
9.3.3. Bedrock Geology

The GSI online 1:100,000 scale bedrock geology mapping (Figure 9-2) indicates the Proposed Development site is underlain by the Lucan Formation. It is comprised of Dinantian (Carboniferous) dark limestone and shale (Calp).

It is described as dark-grey to black, fine-grained, occasionally cherty, micritic limestones that weather paler, usually to pale grey. There are rare dark coarser grained calcarenitic limestones, sometimes graded, and interbedded dark-grey calcar.

No rock outcrops are recorded around the Proposed Development area.

Path: R:\Map Production\2022\P22-242\Workspaces\P22_242_EIAR_Chapter_9.aprx



Legend

- Proposed Development Boundary

Quaternary Sediments

- A, Alluvium
- BasEsk, Eskers comprised of gravels of basic reaction
- Cut, Cut over raised peat
- GLs, Gravels derived from Limestones
- L, Lacustrine sediments
- Rck, Bedrock outcrop or subcrop
- TLs, Till derived from limestones
- Turbine Locations

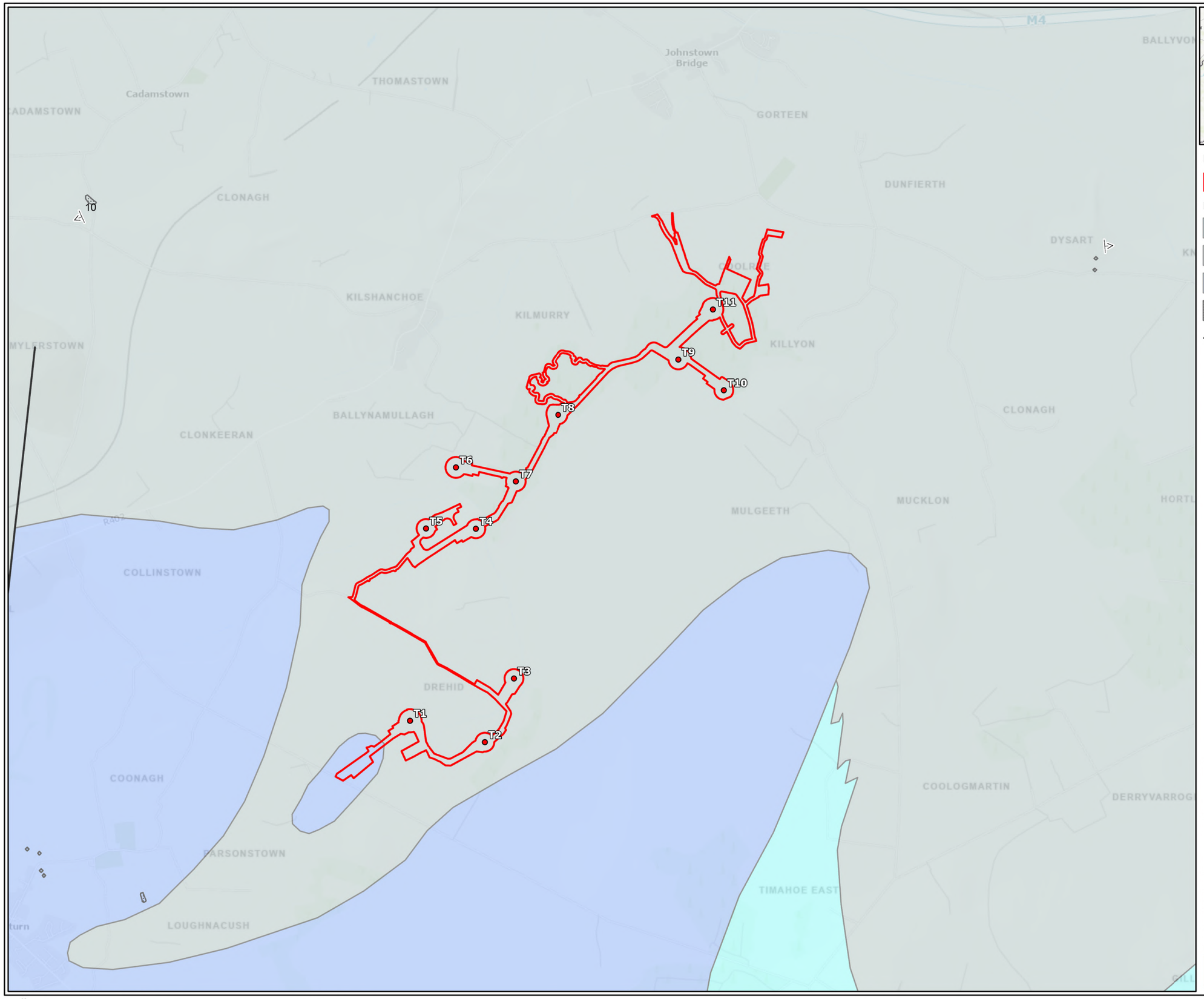
N W E S

0 0.5 1 2 Kilometers

TITLE:	Quaternary Geology		
PROJECT:	Drehid Wind Farm and Substation		
FIGURE NO:	9.1		
CLIENT:	North Kildare Wind Farm Ltd.		
SCALE:	1:30,000	**REVISION:**	0
DATE:	01/05/2025	**PAGE SIZE:**	A3

FEHILY TIMONEY
Cork | Dublin | Carlow
www.fehilytimoney.ie

Path: R:\Map Production\2022\P22-242\Workspaces\P22_242_EIAR_Chapter_9.aprx



Legend

- Proposed Development Boundary

Bedrock Geology

- Allenwood Formation
- Lucan Formation
- Waulsortian Limestones
- Bedrock Outcrops
- Fault
- Strike and dip of bedding, right way up
- Turbine Locations

TITLE:	Bedrock Geology		
PROJECT:	Drehid Wind Farm and Substation		
FIGURE NO:	9.2		
CLIENT:	North Kildare Wind Farm Ltd.		
SCALE:	1:30,000	**REVISION:**	0
DATE:	01/05/2025	**PAGE SIZE:**	A3

FEHILY TIMONEY
Cork | Dublin | Carlow
www.fehilytimoney.ie

9.3.4. Hydrogeology

9.3.4.1. Anticipated Groundwater Regime

The overburden deposits of till and peat have generally low permeability and may therefore act as a confining layer, preventing the free movement of surface water to the underlying aquifer within the bedrock. Nevertheless, due to the high coarse-grained content of the glacial deposits, areas of higher permeability are anticipated, with areas of near surface gravel noted on the western side of the site, but outside the Proposed Development boundary. Besides, groundwater vulnerability has been classified as high by GSI on any till outcrop.

The topography of the Proposed Development site is a depression, and the area is approximately flat. Groundwater tends to stagnate, but it is also expected to slightly flow to the northeast direction towards the Blackwater River where the groundwater flow tends to be discharged.

9.3.4.2. Groundwater Vulnerability

Groundwater vulnerability, as defined by the GSI, is the term used to represent the intrinsic and hydrogeological characteristics that determine the ease with which groundwater could be contaminated by human activities. The vulnerability of an aquifer to contamination is influenced by the leaching characteristics of the topsoil, the permeability and thickness of the subsoil, the presence of an unsaturated zone, the type of aquifer, and the amount and form of recharge (the hydraulic process where water moves downwards from surface water to groundwater).

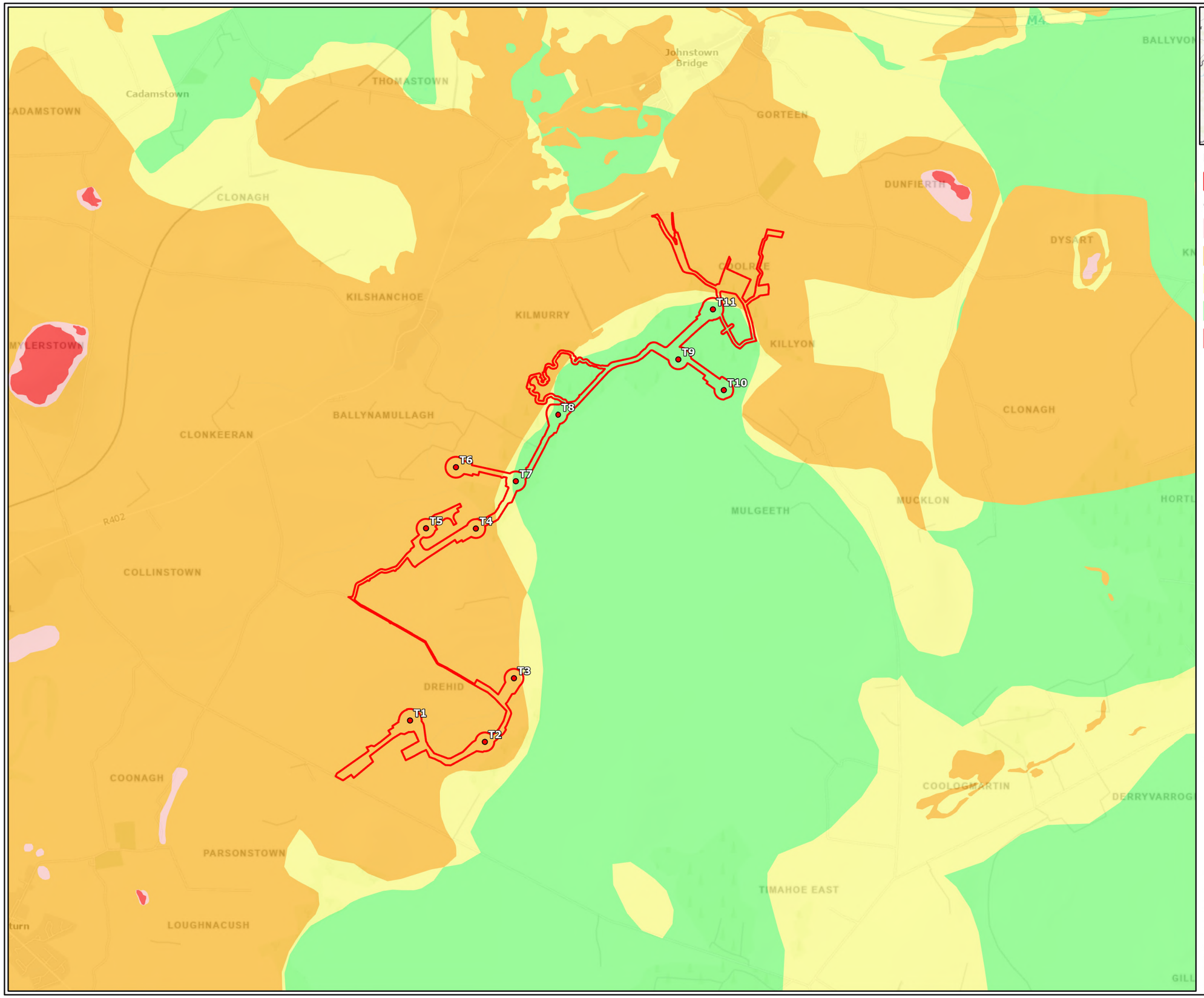
According to GSI aquifer vulnerability mapping, Groundwater Vulnerability within the Proposed Development site ranges from low to high levels, since the Proposed Wind Farm is partly located in areas defined in geological mapping as peat and partly in areas defined as fine and coarse glacial till deposits. The vulnerability on glacial and fluvial deposits is high due to the higher permeability and it is low on the peat overburden. Along the limit of both kinds of deposits, there is a transition strip with moderate vulnerability. Nevertheless, FT confirms typical low permeability cover (peat) under 3.0 m and occasionally between 3.0 – 5.0m. The peat is assumed to be underlain by fine and coarse glacial deposits with moderate to high permeability as shown in GSI records where quaternary deposits are described as “Till derived from limestones” (moderate permeability), and “Gravels derived from Limestones” (high permeability). Nevertheless, till is mostly expected to be underlying the Proposed Development peat cover. Figure 9-3 shows the groundwater vulnerability mapping.

A summary of the groundwater vulnerability for the Proposed Development is presented in Table 9-6. This table outlines the standard ratings of vulnerability used by the GSI, with the existing site conditions highlighted in grey based on the findings of the site walkovers.

Table 9-6: Groundwater Vulnerability

Vulnerability Rating	Hydrogeological Conditions		
	Subsoil Permeability (Type) and Thickness		
	High Permeability (sand/gravel)	Moderate Permeability (sandy soil)	Low Permeability (clayey subsoil, clay, peat)
Extreme (E)	0 - 3.0 m	0 - 3.0 m	0 - 3.0 m
High (H)	> 3.0 m	3.0 -10.0 m	3.0 - 5.0 m
Moderate (M)	N/A	>10.0 m	5.0 - 10.0 m
Low (L)	N/A	N/A	>10 m

Path: R:\Map Production\2022\P22-242\Workspaces\P22_242_EIAR_Chapter_9.aprx



Legend

- Proposed Development Boundary

Groundwater Vulnerability

- E - Extreme
- H - High
- M - Moderate
- L - Low
- X - Rock Near Surface or Karst
- Turbine Locations

TITLE:	Groundwater Vulnerability		
PROJECT:	Drehid Wind Farm and Substation		
FIGURE NO:	9.3		
CLIENT:	North Kildare Wind Farm Ltd.		
SCALE:	1:30,000	**REVISION:**	0
DATE:	01/05/2025	**PAGE SIZE:**	A3

FEHILY TIMONEY
Cork | Dublin | Carlow
www.fehilytimoney.ie

N W E S

0 0.5 1 2 Kilometers

9.3.4.3. Groundwater Bodies (GWB) Description

Groundwater is an important natural resource, with increasing dependence on it as a drinking water supply source. The Proposed Development site is located within the Trim water body as shown in Figure 9-5.

The GSI classifications for the aquifer in the study area, including the principal aquifer characteristics are summarised in Table 9-7, and shown on Figure 9-5. All aquifers in the study area are bedrock aquifers; there are no gravel aquifers within the study area (i.e. a gravel deposit of greater than 1 km^2 with a saturated thickness of greater than 5m).

Table 9-7: Summary of Aquifer Classifications and Characteristics

Aquifer Name	GSI Aquifer Classification	Groundwater Body	Transmissivity (m^2/day)	Well Yields
Unnamed	Locally important aquifer- bedrock which is moderately productive only in local zones	Trim	2- 20 m^2/d	Generally Poor for domestic wells

9.3.4.4. Groundwater Supply Sources

A review of published information on groundwater supply sources within the study area was undertaken to identify potential groundwater dependent receptors at potential risk from the Proposed Development. These include group water schemes (GWS), source protection zones and private supply wells with information on these features obtained from the GSI Groundwater database: **"Public Water Supplies and Source Protection Zones"**.

The GSI maintains a database of Public Supply Source Protection Areas. From a review of the database there is a Public Supply Source Protection Area within the site boundary, in the northern part of the site. It has a total area of 10.1 km^2. Mitigation measures for protecting the Source Protection Zone are described in Chapter 10 - Hydrology and Water Quality, Section 10.8.6.

9.3.4.5. Groundwater Wells

Based on a review of the GSI Groundwater Wells database there are fourteen wells recorded near the Proposed Development in Trim GWB. Based on GSI mapping, there is an accuracy of 10 to 5,000m of the well location. There may also be additional wells not included in the GSI dataset.

Among the GSI recorded wells, four are near the Proposed Substation, one is near Turbine T1, three are near Turbines T2 and T3, four are near Turbine T9, two are near Turbine T10, and the rest of them are located outside of the proposed site boundary.

Table 9-8 below outlines details of groundwater wells held within the GSI dataset within 2 km of the Proposed Development. Well locations are presented in Figure 9-5.

Table 9-8: Summary of Wells with 2km of the Proposed Development

Location ID	Easting	Northing	Type	Total Depth (m BGL)	Well Use	Yield Class	GSI Location Accuracy (m)	Nearest Infrastructure ID	Distance to Nearest Infrastructure (m)
2623SEW169	676333	737827	Borehole	77	Unknown	Excellent	10	Substation	<10 to alignment
2623SEW176	6759223	737411	Borehole	91	Unknown	Moderate	100	T9	<10 to alignment
2623SEW174	675983	737307	Borehole	89.6	Unknown	Moderate	10	T9	<10 to alignment
2623SEW175	675994	737308	Borehole	76.5	Unknown	Moderate	10	T9	<10 to alignment
2623SWW416	674409	735262	Dug well	5.1	Unknown	Unknown	100	T9	480 - 580
2623SEW195	676454	739065	Borehole	51.8	Unknown	Moderate	2000	Substation	100 - 2100
2623SEW101	677524	738706	Dug well	9.1	Unknown	Poor	2000	Substation	200 - 2200
2623SEW105	675464	739535	Dug well	14.9	Unknown	Moderate	2000	Substation	200 - 2200
2623SEW138	677264	736067	Borehole	9.5	Unknown	Poor	2000	T10	200 - 2200
2623SEW165	677304	735966	Borehole	42.7	Unknown	Unknown	2000	T10	300 - 2300
2623SEW127	677154	732197	Borehole	30.5	Unknown	Unknown	5000	T02 & T03	800 - 5800
2623SEW128	677274	732127	Dug well	4.9	Unknown	Poor	5000	T02 & T03	950 - 5950
2623SEW130	677404	731907	Borehole	30.5	Unknown	Good	5000	T02 & T03	1000 - 6000
2623SWW246	672615	733307	Unknown	15.2	Unknown	Unknown	2000	T01	600 – 2600

Location ID	Easting	Northing	Type	Total Depth (m BGL)	Well Use	Yield Class	GSI Location Accuracy (m)	Nearest Infrastructure ID	Distance to Nearest Infrastructure (m)
2623SWW267	672135	735376	Borehole	10.4	Unknown	Unknown	2000	T04	1000 - 3000
2623SWW265	672414	735466	Borehole	26.2	Unknown	Unknown	2000	T04	800 - 2800
2623SWW233	671815	735466	Borehole	10.4	Unknown	Moderate	2000	T04	1200 - 3200
2623SWW272	671795	735376	Borehole	36.8	Unknown	Poor	2000	T04	1100 - 3100
2623SWW213	672165	736665	Borehole	14.6	Unknown	Poor	2000	T04	1000 - 3000
2623SWW235	672155	735476	Borehole	39	Unknown	Poor	2000	T04	1000 - 3000
2623SWW236	672434	735576	Borehole	26.2	Unknown	Moderate	2000	T04	800 - 2800
2623SWW234	672434	735566	Borehole	18.3	Unknown	Unknown	2000	T04	800 - 2800
2623SWW266	672414	735406	Borehole	39	Unknown	Poor	2000	T04	800 - 2800
2623SWW232	671815	735596	Borehole	26.2	Unknown	Moderate	2000	T04	1200 - 3200

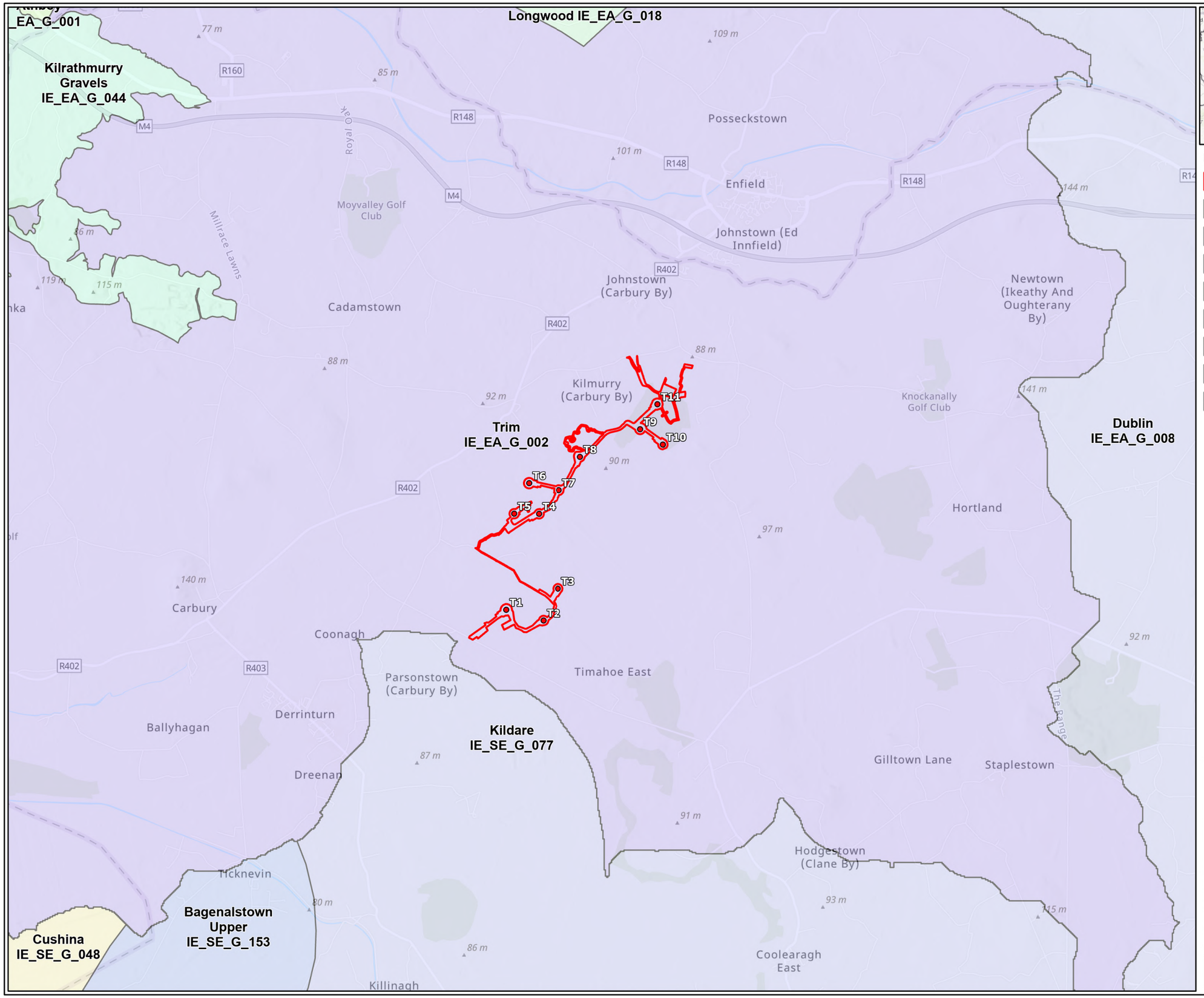
The GSI database is however not complete; it is probable that there are other wells in addition to those in the GSI databases, but are generally associated with houses, the offset to which from the turbines is a minimum of 600m.

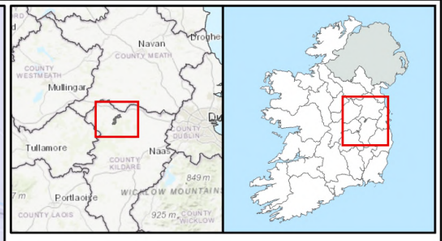
9.3.4.6. Karst Features

According to the GSI datasets, there are no karst features recorded within the Proposed Development site or the wider study area. Karst features are not likely to occur within the Proposed Development site or broader study area due to deep level of rockhead recorded in the relevant boreholes as mentioned in Section 9.3.3.6. The closest mapped karst feature is a groundwater spring within the Lucan Formation, the same rock formation underlying the Proposed Development area, which is located approximately 3km to the northeast of the site (GSI ref. number IE_GSI_Karst_40K_5201)

.

Path: R:\Map Production\2022\P22-242\Workspaces\P22_242_EIAR_Chapter_9.aprx





Legend

- Proposed Development Boundary
- IE_EA_G_001
- IE_EA_G_002
- IE_EA_G_008
- IE_EA_G_018
- IE_EA_G_044
- IE_SE_G_048
- IE_SE_G_077
- IE_SE_G_153
- Turbine Locations

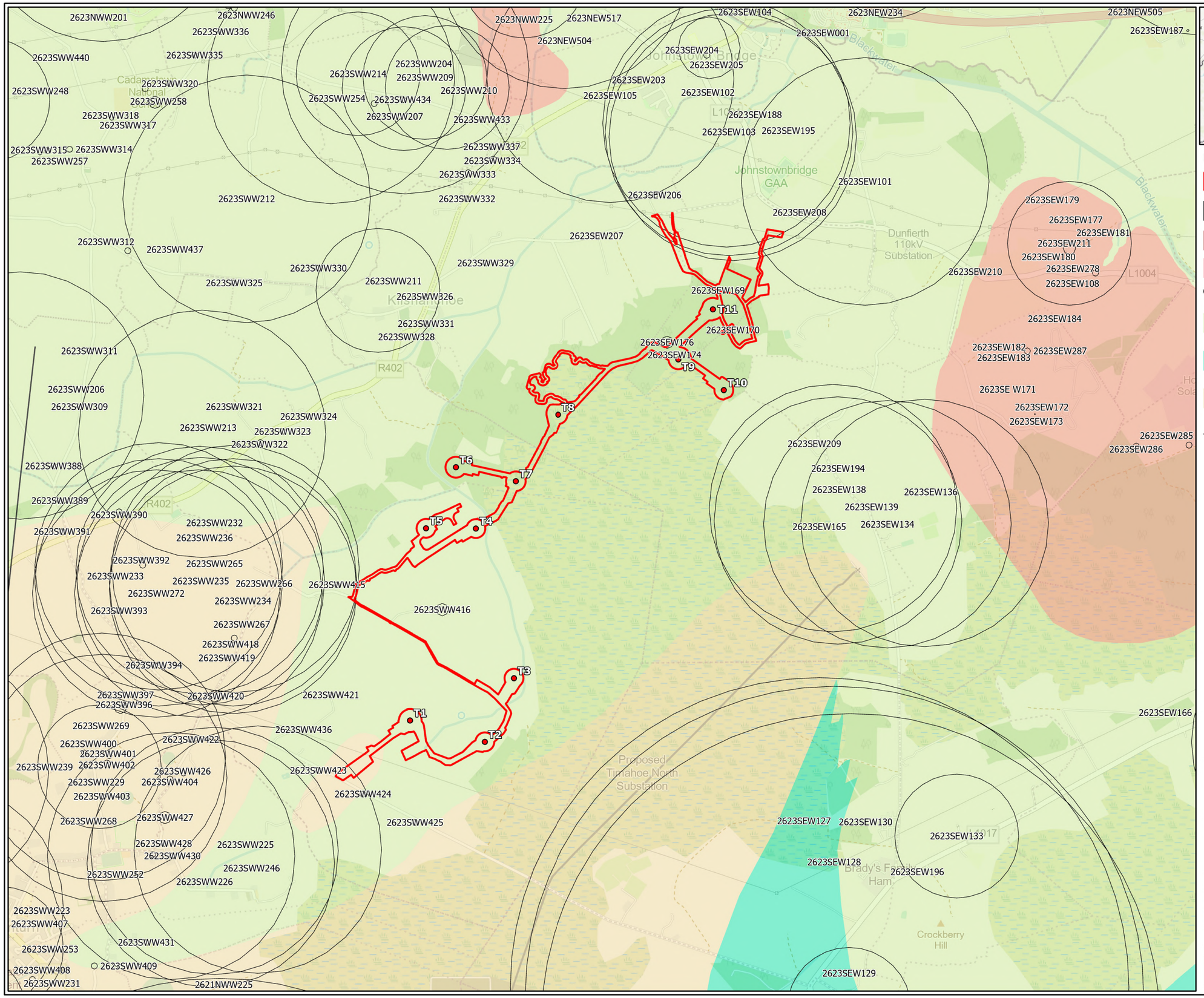
N W E S

0 0.75 1.5 3 4.5 6 Kilometers

TITLE:	Groundwater Bodies		
PROJECT:	Drehid Wind Farm and Substation		
FIGURE NO:	9.4		
CLIENT:	North Kildare Wind Farm Ltd.		
SCALE:	1:60,000	**REVISION:**	0
DATE:	01/05/2025	**PAGE SIZE:**	A3

FEHILY TIMONEY
Cork | Dublin | Carlow
www.fehilytimoney.ie

Path: R:\Map Production\2022\P22-242\Workspaces\P22_242_EIAR_Chapter_9.aprx



Legend

- Proposed Development Boundary
- Groundwater Wells and Springs - circle size is location accuracy
- Regionally important gravel aquifer
- Locally important gravel aquifer

GSI Bedrock Aquifers

- Lm - Locally Important Aquifer - Bedrock which is Generally Moderately Productive
- Lk - Locally Important Aquifer - Karstified
- Ll - Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones
- GSI Aquifer Geological Lines
- Turbine Locations

N W E S

0 0.5 1 2 Kilometers

TITLE:	Aquifer Classification and Groundwater Wells		
PROJECT:	Drehid Wind Farm and Substation		
FIGURE NO:	9.5		
CLIENT:	North Kildare Wind Farm Ltd.		
SCALE:	1:30,000	**REVISION:**	0
DATE:	01/05/2025	**PAGE SIZE:**	A3

FEHILY TIMONEY
Cork | Dublin | Carlow
www.fehilytimoney.ie

9.3.5. Geological Heritage

The GSI - Irish Geological Heritage Section (IGH) and NPWS (National Parks and Wildlife Service) have undertaken a programme to identify and select important geological and geomorphological sites throughout the country for designation as NHAs (Natural Heritage Areas). This is being addressed under 16 different geological themes. For each theme, a larger number of sites (from which to make the NHA selection) are being examined, to identify the most scientifically significant. The criterion of designating the minimum number of sites to exemplify the theme means that many sites of national importance are not selected as the very best examples. However, a second tier of County Geological Sites (CGS) (as per the National Heritage Plan) means that many of these can be included in County Development Plans and receive a measure of recognition and protection through inclusion in the planning system.

The GSI Online Irish Geological Heritage database indicates that there are no audited or unaudited geological heritage areas within the Proposed Development site boundary.

The nearest geological heritage site is located approximately 6km east of the Proposed Development site boundary. This is St Peter's Well (681736E 733148N) and it is located at the base of St Peter's Hill in Dunmurraghill. This warm spring is found in a collapsed well chamber, which has only one, non-intact side remaining.

9.3.6. Economic Geology

The GSI Online Minerals Database accessed via the Public Data Viewer shows a number of active quarries and scattered mineral occurrences in the vicinity of the study area. The nearest active quarries to the site are the Kilsaran Clonard Quarry, Kilrathmurray and the Kilsaran Rathcore Quarry located in Co. Meath and Keegan Quarries Clonard Ltd, Ballyonan, Co. Kildare. The Clonard and Rathcore Quarries produce Limestone aggregates and fill materials. The Keegan Clonard quarry produces washed sand and gravel aggregates. There have also been mineral occurrences recorded surrounding the site that includes zinc, silver and lead. None of these mineral occurrences are located within the site boundary.

Details on other quarries in the vicinity of the site are outlined in Chapter 13, Traffic and Transportation of this EIAR.

The GSI Aggregates database indicates that there is very low to low potential for granular aggregate beneath the north eastern extent of the Proposed Development site, and low to moderate potential for crushed rock aggregate across much of the Proposed Development site.

9.3.7. Walkover Survey Findings

Several walkover surveys for peat testing have been performed at the area by Fehily Timoney as listed below.

A walkover survey was conducted the 31st July and the 1st August 2018 and peat thickness and shear strength were tested at turbines T7, T8, T9, T10 and T11, but testing at T7 was limited to 25m from the proposed turbine location due to access constraints. As such, this turbine was visited at a later date. This visit also included the initial substation location and the access track between T8 and T9.

A walkover survey and peat testing were conducted on 21st February 2023, targeting a second proposed substation location. Peat thicknesses between 0.9-2.3m with an average of 1.45m were encountered, so it was decided to move the proposed substation location nearer to the original proposal.

A walkover survey and peat testing were conducted on 27th October 2023, targeting the third and currently proposed location for the substation. Peat thicknesses between 0.3-1.5m and 0.7m average were encountered.

A walkover survey and peat testing were conducted on 23rd and 26th January 2024, targeting turbines T1, T2, T3, T4, T5, T6 and T7 and their related access tracks.

A final walkover survey was conducted on the 30th September 2024, targeting the northern entrance for oversized turbine components delivery, and the secondary site access from the L50242 public road entrance. Further peat probing was also performed in Coillte lands along the proposed access road alignments from turbines T6 and T7 to turbine T11.

The key findings of the site walkover survey and peat stability assessment are presented below with ground conditions at each infrastructure location summarised in Table 9-9:

- The site geology comprises Limestone Bedrock overlain by Glacial Till and Cutover Peat;
- The peat encountered during the site assessment was found to be highly decomposed to very highly decomposed with a low to high moisture content;
- No evidence of existing ground instability was noted at the site with areas of peat generally being moderately to well drained and the majority of infrastructure locations have been planted with forestry, which is a stability indicator, since forestry needs reasonably competent ground to grow;
- Slope stability analysis shows that the safety values at the proposed infrastructure locations are well above the minimum safety factor required for both short and long-term stability; and
- No evidence of soil contamination was noted during site walkovers.

The peat stability assessment (included as Appendix 9.1) concluded that the risks associated with peat instability are considered to be low and acceptable for the Proposed Development site providing that appropriate mitigation measures are put in place as outlined in Section 9.6.2.5.

A visual assessment of the geological stability of the remainder of the Proposed Development area was also made during the site walkover. The assessment did not highlight any areas of concern in terms of ground stability, steep slopes, unstable rocks etc. No particular mitigation measures are therefore required to maintain the long-term stability of the Proposed Development area although best practice will be followed as outlined in Section 9.6.2.5.

Table 9-9 below shows a summary of the walkovers undertaken.

Table 9-9: Summary of Walkovers Results

Development Element	ITM Coordinates		Peat Depth (m)				Slope (o)	Measured HSV (kPa)		Notes
	Easting	Northing	Min	Max	Ave	No. tests		P	R	
T1	673900	734371	0	0.7	0.3	5	≈2	-	-	Agricultural field
T2	674448	734178	0	0.8	0.2	5	≈2	-	-	Agricultural field
T3	674683	734692	0	0	0	5	≈2	-	-	Agricultural field
T4	674376	735902	0.3	0.5	0.4	5	≈2	-	-	Agricultural field
T5	673973	735903	0	0	0	5	≈2	-	-	Agricultural field
T6	674215	736397	0.3	0.9	0.4	5	≈0	>65	38	Forestry
T7	674699	736283	1.1	1.8	1.4	5	≈0	51	44	Forestry
T8	675037	736824	1.8	5.4	3.3	12	≈0	10	7	Forestry
T9	676010	737264	1.5	4.2	3	11	0-1	8	-	Cut over raised peat
T10	676385	737017	1.8	4.4	3.3	8	≈1	14	-	Cut over raised peat
T11	676290	737676	0.2	1.1	0.7	10	≈1	10	-	Cut over raised peat
SS P03	676525	737896	0.3	1.5	0.7	13	≈2	14	6	Current proposal
AR T1-T2	674140	734014	0	0.6	0.3	6	≈0	20	-	Agricultural field
AR T2-T3	674640	734419	0	0.7	0.3	4	≈0	22	-	Agricultural field

Development Element	ITM Coordinates		Peat Depth (m)				Slope (o)	Measured HSV (kPa)		Notes
	Easting	Northing	Min	Max	Ave	No. tests		P	R	
AR T4-T5	674137	735761	0	0.8	0.1	14	≈0	65	41	Agricultural field
AR T6-T7	674469	736151	0	2.3	1	6	0	53	23	Forestry
AR T8-T9	676002	737382	3.6	3.6	3.6	17	0-3	15	10	Cut over raised peat
AR T9-T10-T11	676382	737020	2.6	4.5	3.5	8	≈0	19	14	Cut over raised peat
AR PR-T04	673716	735535	0	0	0	2	≈0	-	-	Agricultural field
AR T7-T8	674929	736619	0.5	2.7	1.2	5	≈2	14	7	Forestry
AR PR-T11	676220	737902	0	1	0.4	7	7	20	18	Forestry
Compound 1 (South)	673900	734111	0	0	0	1	≈0	-	-	Agricultural field
Compound 2 (North)	676691	737831	1	1	1	1	≈2	38	20	Agricultural field
SS = Substation; AR = Access Road; T = Turbine; PR = Public Road										

9.3.8. Proposed Borrow Pit

No on-site borrow pits will be used for the Proposed Development.

9.3.9. Existing Slope Stability

9.3.9.1. Site Topography

The Proposed Development site sits on flat to undulating sediments, according to GSI physiographic mapping. The site is generally orientated in a Southwest-Northeast direction. The Proposed Development lines up approximately along a cut over raised peat and agricultural fields border on the southern half (between T1 and T4/T5) and along cut over raised peat and forestry border on the northern half (Between T6/T7 and T10/T11). The Proposed Substation is fully located in a flat to undulating forestry area. The peat bog is classified as flat by GSI and the agricultural fields on the western area are classified as flat to gently undulating ice-moulded topography (see Figure 9-11). The site is frequently crossed by drainage ditches of variable sizes.

9.3.9.2. Slope Stability Assessment

The most recent site walkover surveys indicated that peat has the greatest thickness between T6 and T11, with average thickness over 1.5m and a maximum thickness of 5.4m at turbine T8 (see Table 9-9).

Peat depths between T1 and T3, and between T4 and T5 are significantly lower. These access roads, turbines and southern compound are placed on agricultural fields, with soft ground of average thickness under 0.5m and maximum values under 1m. No peat was encountered at the site entrances from public roads (accesses to T1, T4/T5, and at the northern entrance for oversized turbine components delivery).

The Proposed Substation has tested peat thicknesses between 0.3 and 1.5m with an average of 0.7m. No peat has been encountered to the north of the substation.

The Proposed Development area is essentially flat, with slopes recorded during the walkover surveys under 3˚ in any case and between 0-2˚ in most of the cases. This is confirmed by the site topography as explained in Section 9.3.7.1 above. Also, no landslide events have been recorded within the site boundary by the GSI as shown in Figure 9-10.

Based on the data explained in Section 9.3.5 (taken from walkover surveys and GSI mapping), a Peat Stability Assessment was carried out in accordance with the guidelines in the "Scottish Executive (2017) Peat Landslide Hazard and Risk Assessments", with the conclusion that the Proposed Development area does not have any slope instability issue which requires action, with the exception of excavations deeper than 1.5m where peat thickness is also over 1.5m thick, which will require temporary measures for stabilisation.

9.3.10. Summary and Type of Geological/Hydrogeological Environment

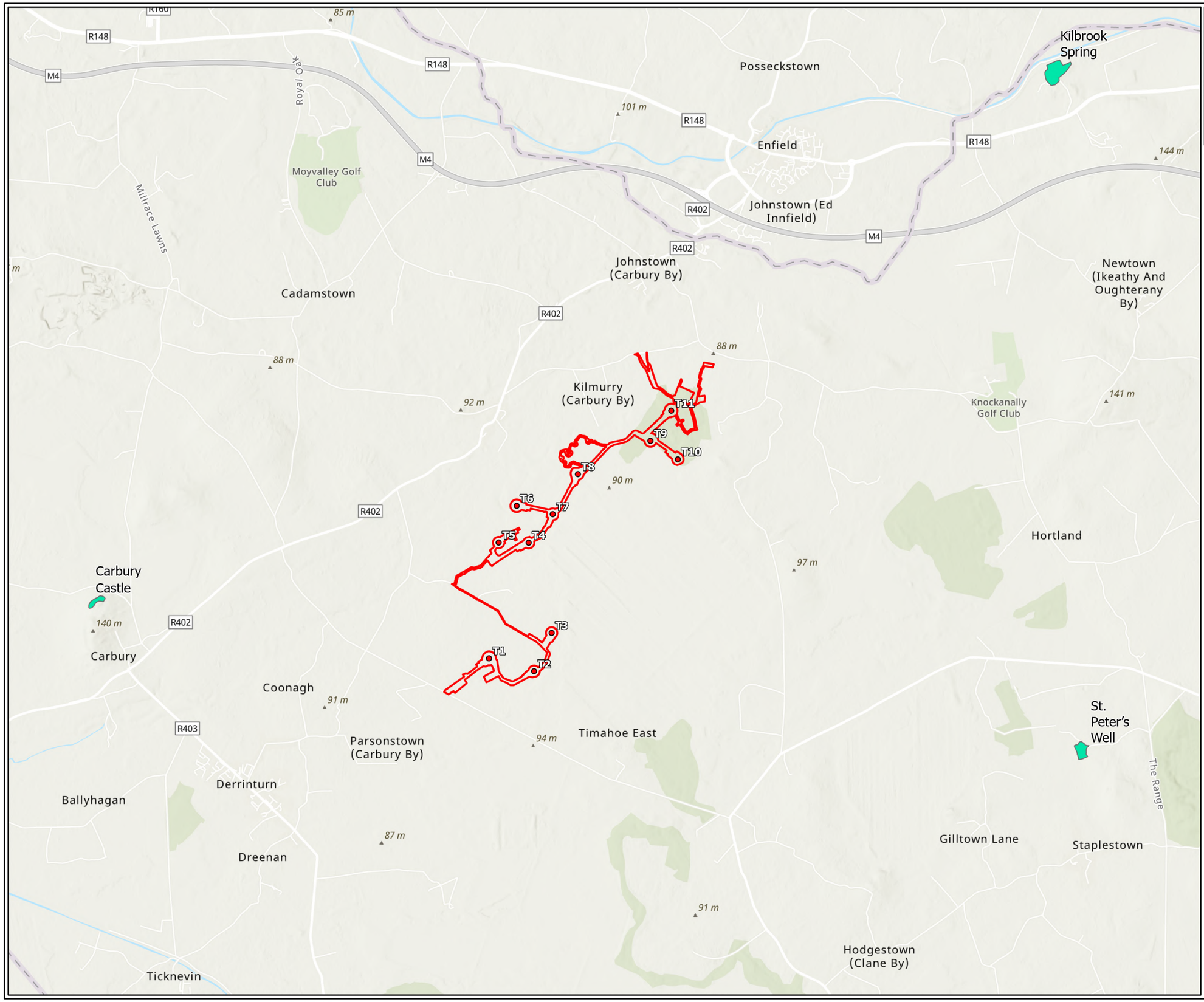
Based on regional and site-specific information available the type of geological/hydrogeological environment as per the IGI Guidelines is **Type A – Passive Geological/Hydrogeological Environments**.

A summary of the Proposed Development sites' geology and hydrogeology is outlined below:

- The overburden deposits of till and peat have generally moderate permeability according to the Groundwater Recharge Mapping, with thicknesses comprise in a range between 26.5 and 33.5mBGL to top of bedrock as described in GSI records.

- Hummocky deposits (sand and gravel deposits with high permeability) are identified to the west of the Proposed Development area, but around 350m away from the Proposed Development site boundary, and upstream, therefore the Proposed Development will not have any impact on this;
- The average subsoil recharge rate across the Proposed Development site and broader study area is very low, ranging from 1 to 50mm/year;
- The Proposed Development site is predominantly underlain by a locally important aquifer. The groundwater flow regime of this underlying bedrock aquifer is described as moderately productive by GSI;
- Immediately to the southeast, at a minimum distance of 300m from the Proposed Development area, a locally important aquifer is moderately productive only in local zones;
- There are some wells mapped within the Proposed Development site and a limited number of wells mapped within the broader study area as described in Table 9-8.
- The Proposed Development area does not have any slope instability issues which requires action, with the exception of excavations deeper than 1.5m where peat thickness is also over 1.5m thick, which will require temporary measures for stabilisation.

Path: R:\Map Production\2022\P22-242\Workspaces\P22_242_EIAR_Chapter_9.aprx



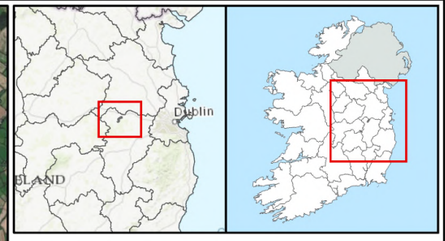
Legend

- Proposed Development Boundary
- Geoheritage Audited Sites Ireland
- Turbine Locations

TITLE:	Geological Heritage		
PROJECT:	Drehid Wind Farm and Substation		
FIGURE NO:	9.6		
CLIENT:	North Kildare Wind Farm Ltd.		
SCALE:	1:50,000	**REVISION:**	0
DATE:	01/05/2025	**PAGE SIZE:**	A3

FEHILY TIMONEY
Cork | Dublin | Carlow
www.fehilytimoney.ie

Path: R:\Map Production\2022\P22-242\Workspaces\P22_242_EIAR_Chapter_9.aprx



Legend

- Proposed Development Boundary

Mineral Localities

- Metallic
- Non-metallic
- Turbine Locations

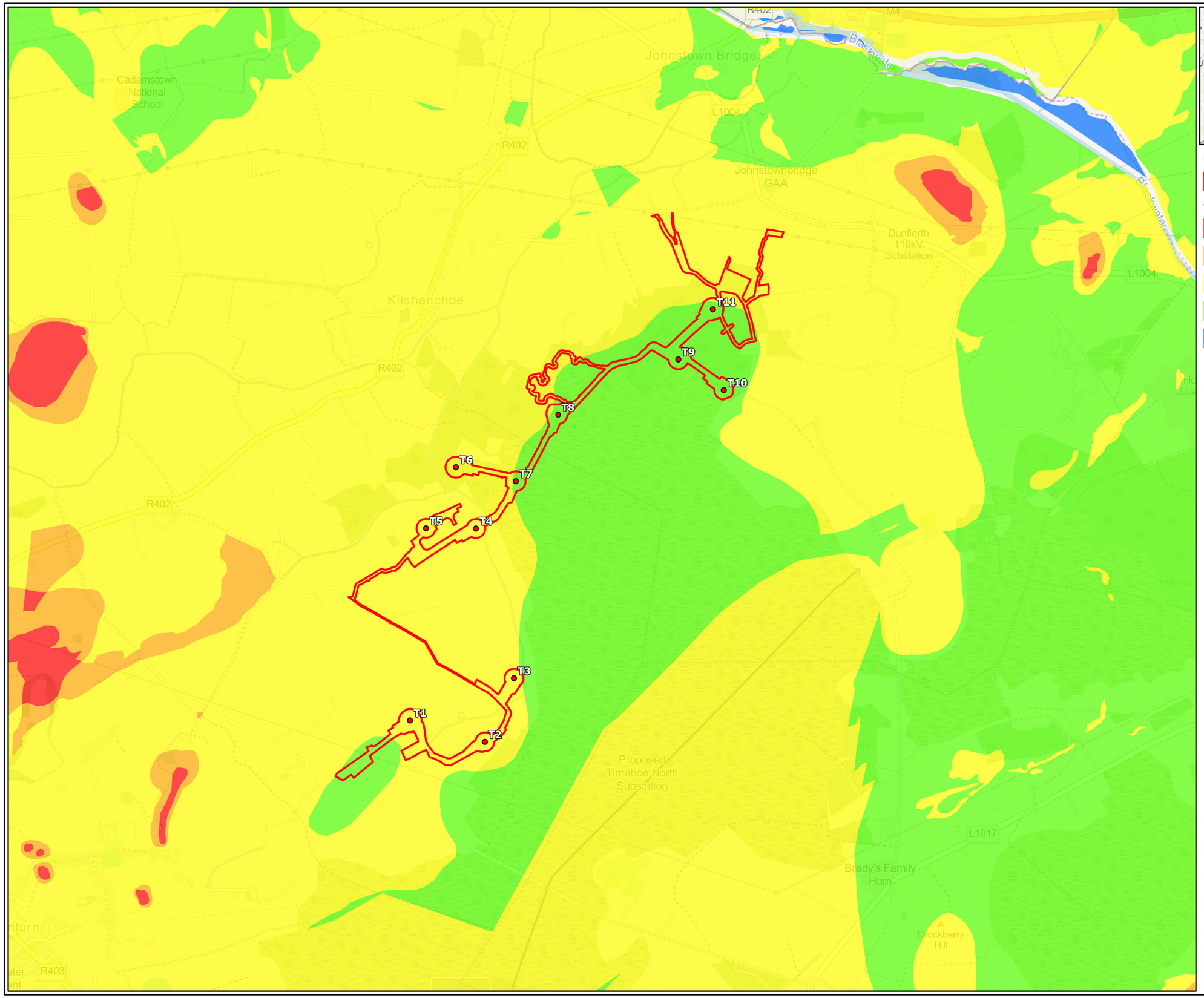
N W E S

0 0.75 1.5 3 4.5 6 Kilometers

TITLE:	Economic Geology		
PROJECT:	Drehid Wind Farm and Substation		
FIGURE NO:	9.7		
CLIENT:	North Kildare Wind Farm Ltd.		
SCALE:	1:100,000	**REVISION:**	0
DATE:	01/05/2025	**PAGE SIZE:**	A3

FEHILY TIMONEY
Cork | Dublin | Carlow
www.fehilytimoney.ie

Path: R:\Map Production\2022\P22-242\Workspaces\P22_242_EIAR_Chapter_9.aprx



Legend

- Proposed Development Boundary

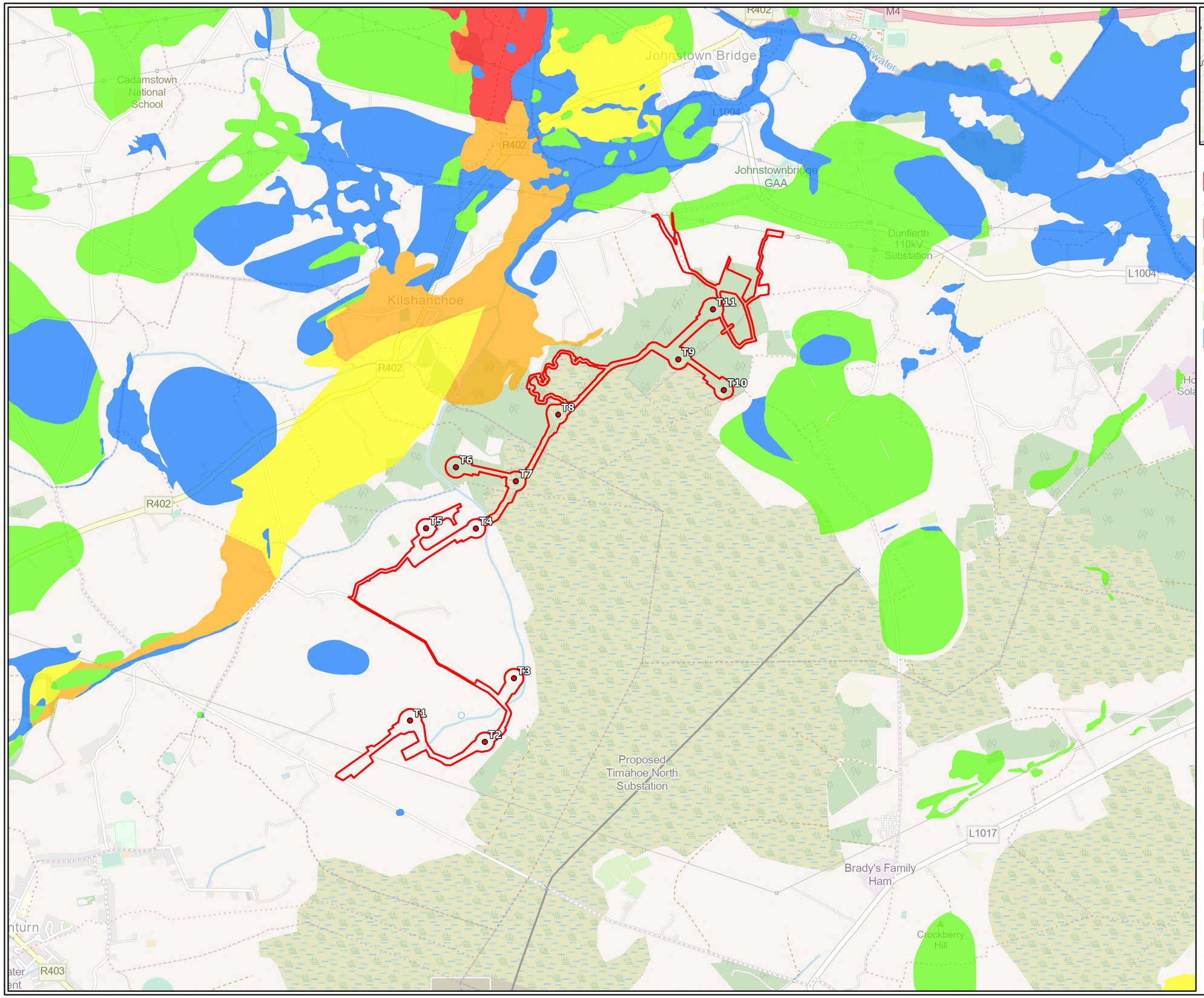
Crushed Rock Aggregate Potential

- Very High potential
- High potential
- Moderate potential
- Low potential
- Very Low potential
- Turbine Locations

TITLE:	Crushed Rock Potential		
PROJECT:	Drehid Wind Farm and Substation		
FIGURE NO:	9.8		
CLIENT:	North Kildare Wind Farm Ltd.		
SCALE:	1:30,000	**REVISION:**	0
DATE:	01/05/2025	**PAGE SIZE:**	A3

FEHILY TIMONEY
Cork | Dublin | Carlow
www.fehilytimoney.ie

Path: R:\Map Production\2022\P22-242\Workspaces\P22_242_EIAR_Chapter_9.aprx



Legend

- Proposed Development Boundary

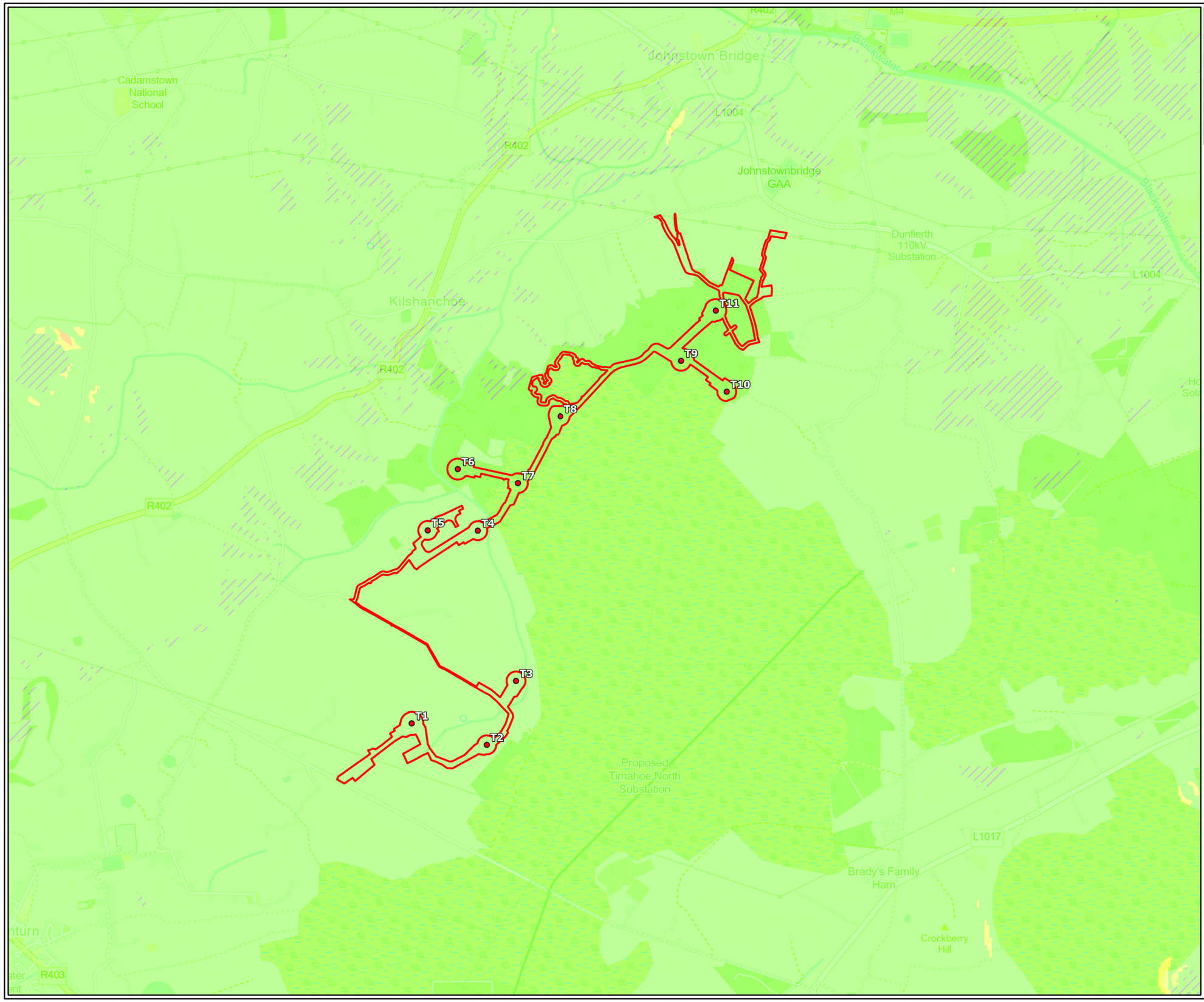
GSI Granular Aggregate Potential

- Very High potential
- High potential
- Moderate potential
- Low potential
- Very Low potential
- Turbine Locations

TITLE:	Granular Aggregate Potential		
PROJECT:	Drehid Wind Farm and Substation		
FIGURE NO:	9.9		
CLIENT:	North Kildare Wind Farm Ltd.		
SCALE:	1:30,000	**REVISION:**	0
DATE:	01/05/2025	**PAGE SIZE:**	A3

FEHILY TIMONEY
Cork | Dublin | Carlow
www.fehilytimoney.ie

Path: R:\Map Production\2022\P22-242\Workspaces\P22_242_EIAR_Chapter_9.aprx



Legend

- Proposed Development Boundary

GSI Landslide Susceptibility Classification

- Low (inferred)
- Low
- Moderately Low
- Moderately High
- Turbine Locations

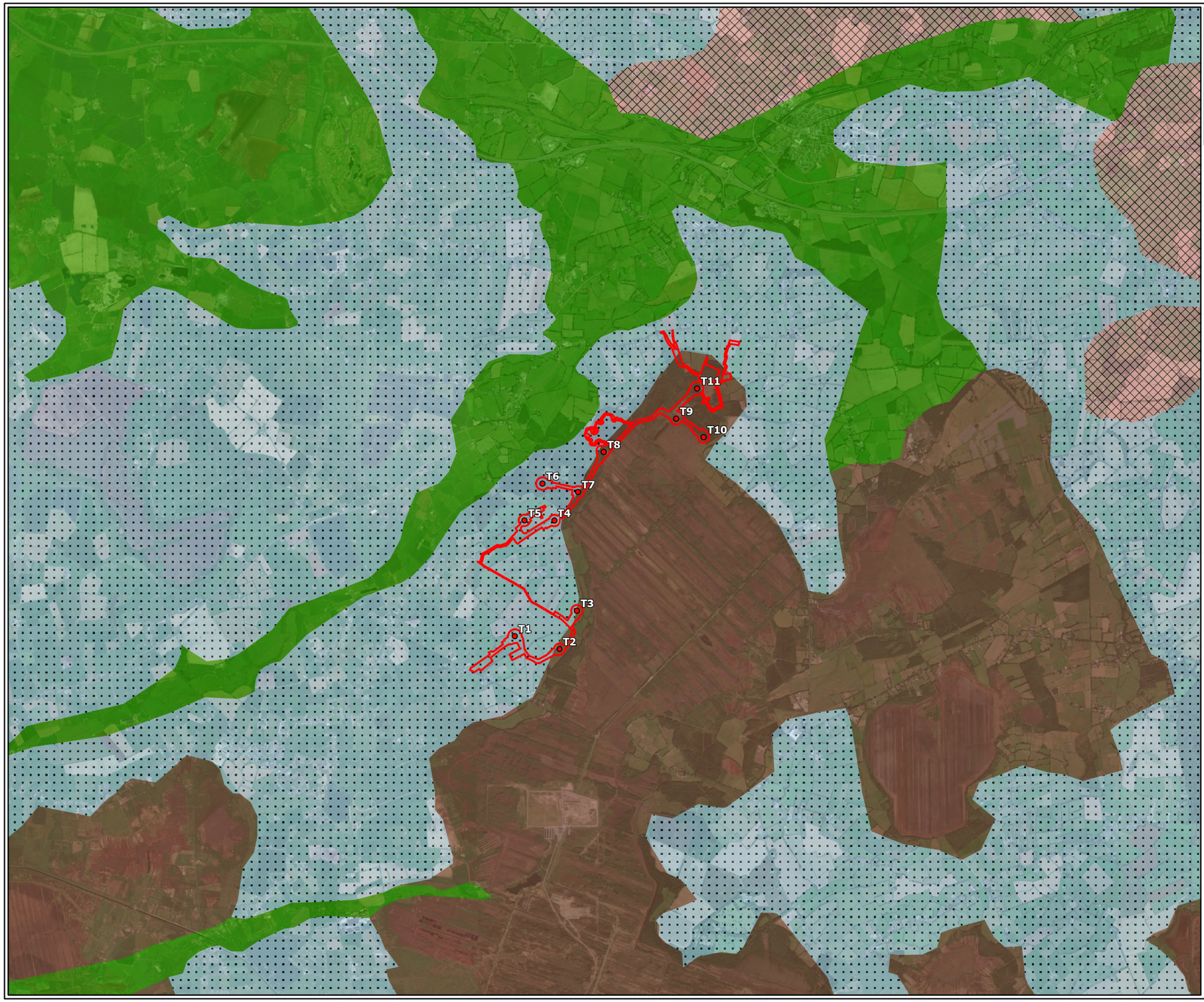
N
W E
S

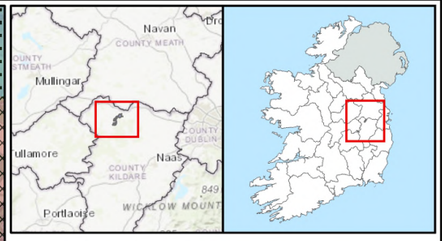
0 0.5 1 2 Kilometers

TITLE:	Landslide Susceptibility		
PROJECT:	Drehid Wind Farm and Substation		
FIGURE NO:	9.10		
CLIENT:	North Kildare Wind Farm Ltd.		
SCALE:	1:30,000	**REVISION:**	0
DATE:	01/05/2025	**PAGE SIZE:**	A3

FEHILY TIMONEY
Cork | Dublin | Carlow
www.fehilytimoney.ie

Path: R:\Map Production\2022\P22-242\Workspaces\P22_242_EIAR_Chapter_9.aprx





Legend

- Hill to rolling lowland rounded bedrock
- Flat to gently undulating ice-moulded topography
- Hummocky glaciofluvial sediments topography
- Bog plain
- Proposed Development Boundary
- Turbine Locations

N
W E
S

0 0.5 1 2 Kilometers

TITLE:	Physiographic Units Level 2		
PROJECT:	Drehid Wind Farm and Substation		
FIGURE NO:	9.11		
CLIENT:	North Kildare Wind Farm Ltd.		
SCALE:	1:50,000	**REVISION:**	0
DATE:	01/05/2025	**PAGE SIZE:**	A3

FEHILY TIMONEY
Cork | Dublin | Carlow
www.fehilytimoney.ie

9.4. Characteristics of the Proposed Development

9.4.1. Proposed Wind Farm

The Proposed Wind Farm involves the construction of eleven wind turbines, internal access tracks, hard standings, internal electrical and communications cabling, two temporary construction compounds, drainage infrastructure and all associated works related to the construction of the Proposed Development.

Estimated volumes of overburden (topsoil, peat and mineral soil) to be excavated are shown in Table 9-10.

All aggregate for construction will be sourced from an offsite quarry as described in Section 9.3.6.

Estimated stone volumes of 131,422m^3 (Table 9-10) will be required for the construction of temporary and permanent access roads, hardstands, compounds and turbine bases. A partial factor of 1.15 has been applied to an unfactored estimation 114,280m^3 in order to allow a 15% contingency.

Due to the possibility of soil-borne diseases, all topsoil/peat recovered from any farm property will remain on site. Excavated Peat/Topsoil and overburden will be used for landscaping and will also be used for reinstatement purposes around turbines bases and hardstandings.

Some temporary stockpiles of material will be necessary adjacent to excavations prior to transportation to permanent storage locations within the development boundary. However, no permanent stockpiles of material will remain after construction. Excavated topsoil and peat will be used for landscaping and berms.

Estimates of the volumes of aggregate required and excavation volumes are presented below in Table 9-10.

Table 9-10: Aggregate and Extraction Volumes for the Proposed Wind Farm

Item	Typical Dimensions	Total Excavated Material (m^3)	Total Imported Aggregate Requirement (m^3)	Comment
Access tracks, compounds and blade transfer area	6m of excavation width for new access roads and 4m of excavation width for existing access roads widenings	1,925	62,743	Both new and existing roads are to be floated, excluding site entrance to Turbine T1 (excavation depth = 0.4m), and access track and platform to overhead line (excavation depth = 0.3m). Therefore, excavation volume = 0m^3 has been assumed for the remainder of the access tracks.
11 no. Turbine Foundations	24m diameter and 3m depth excavation footprint for turbine foundation	12,612	2,861	Piled foundations have been assumed for Turbines T8, T9 and T10.

Item	Typical Dimensions	Total Excavated Material (m^3)	Total Imported Aggregate Requirement (m^3)	Comment
				Average Stone Depth of 1.0m for every hardstand excluding T7 (Stone Depth = 1.7m), and T11 (Stone Depth = 1.3m).
11 no. Hardstandings and 2 no. compounds	hardstand area (3,997m^2 footprint per hardstand area).	32,264	65,818	Piled Hardstands have been assumed for Turbines T8, T9 and T10. Average Stone Depth of 1.0m for every hardstand excluding T7 (Stone Depth = 1.7m), and T11 (Stone Depth = 1.3m).
1 no. Grid Connection	Trench cross-sectional area is 0.72m^2. The anticipated overall trench length is 694m.	670	-	Backfilled with excavated material.
Internal Cable Trenching	Trench cross-sectional area is 0.90m^2. The anticipated overall trench length is 6,941m.	4,059	-	Assumes a typical 0.6m wide and 1.20m deep trench construction. Backfilled with excavated material.
On Site Drainage	Assumed: 1m wide 0.4m deep	3,610	0	In peat areas assumed as side cast adjacent to ditch, other areas require storage. No fill is required.
TOTAL:	-	55,140	131,422	

Note (1) A factor of 10% (bulking factor of 5% and contingency factor of 5%) has been applied to the excavated volumes to allow for expected increase in volume upon excavation and to allow for a variation in ground conditions across the site.

Note (2) A contingency factor of 15% has been applied to imported aggregate volumes to allow for expected increase in volume upon possible contingencies.

Surplus topsoil/peat/subsoil recovered from excavations will be used for landscaping berms along existing and new access tracks and for reinstatement purposes around turbine bases and hardstands. These berms will be created from suitable excavated material and are located on the opposite side of infrastructure to any interceptor drains. The berms will therefore not obstruct flow or risk siltation to interceptor drains. Berms will be placed outside the roadside drains which drain the new access tracks. The location of berms is illustrated in Chapter 3 of this EIAR.

Some temporary stockpiles of material may be necessary prior to reinstatement; however, no permanent stockpiles of material will remain after construction and no surplus material will be removed off site.

It is expected that excavated material will mostly be peat and fine spoil from till derived from limestones. Therefore, it is not feasible to reuse excavated material as coarse general fill. All coarse fill material is required to be imported from an approved quarry.

9.4.2. Proposed Substation

Estimated volumes of material to be excavated and stone volumes required for construction of the Proposed Substation are presented in Table 9-11.

Excavated material from the Proposed Substation will be stored in the "Deposition Area" as shown on planning drawing 23727-MWP-00-00-DR-C-0101.

Table 9-11: Proposed Substation Estimated Excavation and Stone Fill Volumes

Infrastructure Element	Typical Dimensions	Excavation Volume (m^3)	Stone Fill Volume (m^3)
Substation	23,000m^2 footprint	12,657	25,300

Note (1) A contingency factor of 15% is applied to the stone volumes to allow for a variation in ground conditions across the site.

9.5. Potential Effects

The potential effects on the underlying soils, geology and hydrogeology at the Proposed Development site are assessed in the following sections for the activities associated with each phase (Construction, Operation and Decommissioning) for the Proposed Development as described in Chapter 3.

The potential impacts are assessed in accordance with the evaluation criteria outlined in Section 9.2.3. The unmitigated potential impacts are summarised in Table 9-13 and Table 9-14. The proposed mitigation measures are then considered to reduce or eliminate potential impacts.

9.5.1. Do Nothing Impact

If the Proposed Development were not constructed, it is likely that the current land uses will continue for the foreseeable future. The impact on the Soils, Geology & Hydrogeology would remain unaltered as a result.

9.5.2. Construction Phase

9.5.2.1. Potential Direct Impacts of Proposed Development

The following on-site activities have been identified as the sources of potential impacts on the existing geological and hydrogeological conditions during the construction phase of the Proposed Wind Farm:

- Construction of wind turbine foundations and hardstanding areas
- Construction of new access tracks and widening of existing tracks
- Construction of site drainage
- Minor alterations to public roads for turbine delivery
- Construction of substation
- Construction of temporary site compounds
- Cable trench and grid connection construction (including two steel lattice masts for loop-in connection)
- Soil excavation and permanent site storage/landscaping
- Temporary material storage
- Drainage
- Tree Felling
- Vehicular movement
- Storage and use of fuels
- Installation of wastewater holding tank for site compound and substation

9.5.2.2. Potential Indirect Impacts

Construction of the turbines, and cable trenches will require excavation of the soil to founding level with access being provided from existing and newly constructed tracks. Existing track widenings and newly constructed tracks are proposed to be floated and limited excavation is required as shown in Table 9-10. Hardstands at turbines T8, T9 and T10 are planned to be piled and a limited excavation of 300mm has been estimated for them.

The importation of granular fill and other products in the form of concrete or other construction related products will have a permanent impact on the source quarries.

Impacts associated with slope failure or instability may result in injury, damage to property, land or resources which are down-gradient of the Proposed Development site. However, based on the slope stability assessment, this is unlikely to occur.

The dewatering of excavations could potentially have indirect impacts such as reduction of yields to the Source Protection Zone (SPZ) within the site boundary, any nearby wells, reduction to the baseflow of streams or affect the groundwater hydrology of remnant bog.

Any groundwater removed will be directed to the nearest settlement pond to remove fines and discharged to the local drainage network, which in turn discharges to the local streams. Therefore, there will be no significant net loss to the stream baseflow.

Erosion of soil from stockpiles or soils exposed in excavations could impact on quality of receiving surface waters.

Cable trenches may present a preferential pathway for the movement of groundwater and / or contamination in the subsurface.

The significance of these potential impacts, prior to mitigation, is considered to be of slight significance.

9.5.2.3. Earthworks

The Proposed Development will require construction phase earthworks associated with the excavation of turbine bases, removal of overburden deposits for the construction of turbine foundations, temporary site compounds, substation , turbine hard standings, drainage system, and internal access roads.

As such there is the potential for impact to Soils, Geology and Hydrogeology from the excavation and movement of Peat and Glacial Till deposits during the construction phase of the Proposed Development.

The following earthworks excavations will be required:

- Excavation of Topsoil deposits;
- Excavation of Peat;
- Excavation of Glacial Till .

The following fill and material deposition operations will be required:

- Deposition of surplus topsoil, peat, and spoil in berms for reinstatement purposes around turbine bases hardstands (clearfell storage areas) and along access tracks as per P22-242-0100-0001 to P22-242-0100-0006-Material placed alongside access roads will not exceed 1.4m in height and will be shaped and sealed to prevent the ingress of water. Material placed at clearfell storage areas will generally not exceed 1.5m in height, with exception of clearfell storage around Turbine T11, with a maximum height of 2.5m with a perimeter berm.
- Imported General Fill and Engineering Aggregates from off-site quarry.

Following the completion of preliminary site investigations and consideration of wind turbine manufacturer specifications for the Proposed N133 turbine, it is expected that most of wind turbine foundations shall be reinforced concrete gravity foundations with an excavation depth of 3m and a diameter of 23 m. Ideally, a suitable bearing stratum is encountered within 3m from ground surface so that the turbine foundation can be finished at / near existing ground level. Where deeper excavations (3-4m) are required to reach a suitable bearing stratum, soil replacement (engineered fill) is used to bring up the excavation so that the turbine foundation is finished at / near existing ground level. Nevertheless, Turbines T8, T9, T10 and related hardstands are to be piled due to the depth of peat present. The following is recommended:

- Confirmatory Intrusive Ground Investigation prior to construction stage;
- Ground Inspection during earthworks by a suitably qualified and experienced geotechnical engineer or engineering geologist;
- An appropriate testing regime should be planned and followed during construction stage to confirm design geotechnical assumptions.

Surplus Topsoil, Peat and Glacial Till recovered from excavations will be used for the Proposed Development reinstatement proposed around turbine bases, hardstands, in berms along access tracks, and a storage area to east of the substation . All associated quantities have been calculated in Section 9.4 and no excavated material will leave the Proposed Development area.

Direct impacts to the existing geological regime associated with the construction phase of the Proposed Development are:

- Soil compaction may occur due to movement of construction traffic. This will occur particularly within areas of highly compressible soft deposits which are left in-situ during the construction phase. This could lead to an increase in surface water runoff due to reduced infiltration of rainfall and subsequently to an increase in erosion of overburden deposits left in-situ;
- The use of plant and machinery during construction will require the storage and use of fuels and oils. Their storage and use present potential for spills and leaks which could contaminate underlying exposed soils;
- During construction, imported engineering fill and excavated soils will be exposed in excavations and in temporary stockpiles. These soils will be subject to erosion by wind and rain which could deposit silt in streams with an indirect impact on surface water quality;
- The extraction of rock from off-site quarries will represent a reduction in the availability of an exhaustible resource. Imported crushed rock will be required for material such as 6F2 (capping), 6N1 (Fill to structures) and 6N2 (fill below structures). Granular soil can be accepted as General Fill (Class 1 material according to Series 600). However, no significant amount of granular soil is expected to be extracted during site excavations, hence Class 1 material is also expected to be imported from off-site sources.

The Magnitude of the impact from these works on the soils and geology receptors is considered to be 'Slight Adverse' in nature. The importance is considered to be 'Medium'. The rating of these potential impacts, prior to mitigation, is considered to be of **Slight significance.** The Impact Classification is negative, permanent, direct and will have likely effects.

Direct impacts to the existing hydrogeological regime associated with earthworks with respect to the construction phase of the Proposed Wind Farm are:

- Potential for groundwater pollution from the removal of overburden deposits particularly at proposed turbine locations. The aquifer vulnerability underlying the Proposed Development site is classified by the GSI as ranging from 'High' to 'Low'. The High/Low Vulnerability border is generally following the blanket peat border. The aquifer vulnerability is low in the blanket peat area and high out of it. Nevertheless, it is required to remove peat overburden in every turbine with gravity foundation, and underlying material in piled turbines (T8, T9 and T10) shall also be reached. Therefore, high vulnerability for local aquifers must always be assumed in the Proposed Development Area;
- It is proposed to remove the overlying soft ground to competent founding level for every none-piled hardstand and turbine (excluding Turbines T8, T9 and T10), and also for the Proposed Substation. That will include full peat thickness and any soft glacial till if present, subject to being inspected by a suitably qualified and experienced geotechnical engineer or engineering geologist prior to being accepted as a competent founding level;
- Potential for silt infiltration to groundwater as a result of increased surface runoff and reduced protection of the aquifer. Soil erosion as a result of exposure of soils in open excavations and temporary storage of excavated materials represents a potential impact to the underlying groundwater aquifer;

- Reduction in groundwater levels from dewatering of excavations as required during the construction stage if high groundwater is encountered. This impact is most likely during the excavation of gravity founded turbines. There are possible groundwater supply wells recorded in the vicinity of the proposed turbine locations T1, T2, T3, T9, T10 and also near the Proposed Substation. Nevertheless, it is considered that no excavations associated with the Proposed Wind Farm Development or the Proposed Substation development will extend into the underlying bedrock aquifers, as the expected depth to bedrock, according to GSI records, is deeper than the planned excavation. Nevertheless, this is to be confirmed through confirmatory ground investigation.
- It is possible that perched groundwater may exist within the glacial deposits or weathered bedrock might be reached during piling works at turbines T8, T9 and T10. Upon completion of the construction phase, it is considered that groundwater levels will revert to the pre-construction situation when there is no longer a requirement to control groundwater levels.

The Magnitude of the impact from these works on groundwater receptors is considered to be 'Moderate Adverse' in nature. The importance is considered to be 'Medium'. The rating of these potential impacts, prior to mitigation, is considered to be of **Moderate significance.** The Impact Classification is negative, permanent, direct and will have likely effects.

9.5.2.4. Slope Stability

Slope stability during wind farm construction was highlighted following a construction-related bog burst at the Derrybrien Wind Farm in County Galway in 2003, and in the Stack's Mountains near Tralee County Kerry and Drumkeeran County Leitrim, both in 2008. More recently, landslides have occurred in Ireland following exceptionally heavy rainfall events. As many wind farms are proposed in upland areas, typically with blanket bog, the assessment of slope stability has become an important factor in the siting and design of wind farms.

The factors that could act as triggers to the failure of slopes during the construction of wind farms include:

- Alteration of drainage patterns focusing drainage and generating high pore water pressures along pre-existing or potential slip surfaces;
- Rapid ground accelerations (i.e. mechanical vibrations) causing an increase in shear stresses;
- Unloading of peat mass by cutting of peat at the toe of the slope;
- Loading of peat mass by heavy plant, structures or overburden;
- Digging and tipping undermining or loading the peat mass during building, engineering, farming or mining activities;
- Afforestation of peat areas reduces water held in the peat body and increases the potential for the formation of desiccation cracks which are exploited by rainfall on forest harvesting; and;
- Changes to vegetation cover or stripping of surface peat cover, reducing tensile strength.

Following the site walkover, a review of the potential for a landslide hazard as outlined in Figure 3.1 of the Scottish Executive – Peat Landslide Hazard and Risk Assessments (2017) was carried out.

The results of the peat stability assessment recorded FoS results for existing in-situ peat stability. Based on the analyses presented, the development areas are considered stable since no data points were recorded to have a FoS of less than 1.3.

In summary, the results give rise to in-situ safety ratios for translational slides which are above the minimum required value for all infrastructure locations analysed. Calculated safety ratios when an additional surcharge is included in the analysis give rise to lower safety ratios, however no FoS results fall below 1.3.

According to the GSI Landslide Susceptibility database, the Proposed Development site is generally located within areas of 'Negligible' landslide susceptibility (see Peat Stability Report P22242-FT-ZZ-01-RP-GE-0001 presented as Appendix 9.1). However, GSI Quaternary mapping and site observations indicate peat thickness is considerable to north of Turbine T4, and specially to north of Turbine T7, where thicker peat layers have been identified. Therefore, some mitigation measures are recommended during construction stage for heavy traffic and excavations as shown in report P22242-FT-ZZ-01-RP-GE-0001, Section 8.2). Nevertheless, it is considered construction activities will pose little risk to sensitive receptors from potential landslide/slope failures. Results from the site walkover surveys show no evidence of recent or historic landslides. In conclusion, peat stability hazards at the site of the Proposed Development represent a very low risk.

The Magnitude of the impact from these works on the soils and geology receptors is considered to be 'Moderate Adverse' in nature. The importance is considered to be 'Medium'. The rating of these potential impacts, prior to mitigation, is considered to be of **Moderate significance.** The Impact Classification is negative, short term, direct and will have unlikely effects.

The Magnitude of the impact from these works on groundwater receptors is considered to be 'Small Adverse' in nature. The importance is considered to be 'Medium'. The rating of these potential impacts, prior to mitigation, is considered to be of **Slight significance.** The Impact Classification is negative, short term, direct and will have unlikely effects.

9.5.2.5. Vegetation Clearance

Recurrent traffic of machinery and other heavy vehicles results in soil compaction of soft deposits and an increase in surface water runoff resulting in increased erosion of exposed soils.

The magnitude of the impact from these works on the soils receptors is considered to be 'Small Adverse' in nature. The importance is considered to be 'Medium'. The rating of this potential cumulative impact is considered to be of **Slight significance.** The Impact Classification is negative, short-term, indirect and has unlikely effects.

There is the potential for groundwater pollution from run-off impacting on the groundwater receptor from the development sites. The Magnitude of the impact from these works on the groundwater receptors is considered to be 'Small Adverse' in nature. The importance is considered to be 'Medium'. The rating of this potential cumulative impact is considered to be of **Slight significance.** The Impact Classification is negative, short-term, indirect and has unlikely effects.

9.5.2.6. Enabling TDR Works

The proposed turbine delivery route (TDR) will be from the M4 Motorway along R402, as described in more detail in Appendix 13.1 and shown in Figure 3.4. Key elements of the Enabling TDR Works are summarised below.

From the main site entrance, the components being delivered for turbines T01, T02 and T03 can be delivered directly to their respective hardstanding locations. However, an alternative delivery route is required for delivery of the components of the remaining turbines (T04 to T11).

To deliver the blades for turbines T4 to T11:

- The blades will be set down at the designated set down area inside the main site entrance;
- The blades will then be transferred onto a blade lifting trailer;
- The blade lifting trailer will carry the blades back out the main site entrance, and turn right onto the L5025, to proceed northwest;
- The blade lifting trailer will turn right onto the R402 and proceed northbound;
- At the Raven Junction, loads will turn right onto Kilshanroe Road and will continue eastbound to a new, temporary site access which will be constructed specifically for the purpose of turbine delivery;
- Loads will turn right off Kilshanroe Road into the new temporary site entrance.
- The new site entrance will lead to a new access track, which will join the existing Coillte access track, north of the T11 location at ITM coordinates 676175, 737950. This entrance and stretch of access track will only be used for the delivery of oversized turbine components and will not be used for typical construction/operational traffic.

For the other turbine components for T4 to T11 (excluding the blades) the route will be the same, but the components will not be required to be transferred onto a blade lifting trailer, and so turbine loads will undertake a U-turn and will rejoin the L5025, proceed northwest.

Due to the oversized nature of the wind turbine components, some alterations will be required along the route to include removal of street furniture and laying of hardcore in the verge of the road corridors. .

The Enabling TDR Works will include a new site entrance at the northern extent of the site which will be used for Turbine Delivery only. This new entrance will lead to the site via a new floated access track. Floated road construction involves minimum excavation limited to clearance and levelling. Therefore, the potential impact due to exposure of the overburden and underlying bedrock to erosion via surface water ingress during the works is expected to be negligible.

The Magnitude of the impact from these works on the soils and geology receptors is considered to be 'Small Adverse' in nature. The importance is considered to be 'Medium'. The rating of these potential impacts, prior to mitigation, is considered to be of **Slight significance**. The Impact Classification is negative, temporary, direct and has likely effects.

The Magnitude of the impact from these works on the groundwater receptors is considered to be 'Small Adverse' in nature. The importance is considered to be 'Medium'. The rating of these potential impacts, prior to mitigation, is considered to be of **Slight significance.** The Impact Classification is negative, temporary, direct and has likely effects.

Following the identification of the potential direct impacts during the construction phase, as outlined above, mitigation measures to reduce the risk to an acceptable level are discussed in Section 9.6 of this Chapter.

9.5.3. Turbine Foundation Construction

N133 turbines proposed for the Proposed Wind Farm will have foundation depths of 3 m and diameters of 23 m. Ideally, a suitable bearing stratum is encountered within 3 m from ground surface so that the turbine foundation can be finished at / near existing ground level. Where deeper excavations are required to reach a suitable bearing stratum, soil replacement (engineered fill) is used to bring up the excavation so that the turbine foundation is finished at / near existing ground level.

Where excavations beyond 5m below ground level are required to reach a suitable bearing stratum, pile foundations may be required. Piles used for turbine foundations will be bored piles. Pile length is site-specific, but are expected to be 25 m long on the Proposed Wind Farm site and 1.0m in diameter. Pile lengths and sizes will be confirmed following confirmatory ground investigation.

9.5.3.1. Internal Access Roads, Hardstands, and Temporary Construction Compound

The excavation for hardstanding areas construction of access tracks have the potential to give rise to direct permanent impacts on the exposed soils, in the form of increased erosion and sediment release and compaction of peat and soft soils that could also have additional impacts on water quality due to sedimentation of water courses and increased runoff (see Chapter 10 Hydrology and Water Quality). Tree felling and vegetation clearance may also have the potential for similar impacts on the existing soils due to erosion and sediment release.

Existing tracks have been utilised and will be upgraded where appropriate. Elsewhere, new access tracks will be constructed. The tracks will permit access for construction vehicles and for maintenance vehicles during the operational phase. The tracks will be 4.5m wide along straight sections and wider at bends and as required as shown on planning application drawings. The tracks will not be surfaced however; they will be well drained and culverted where required. Drainage is discussed in more detail in Chapter 10 Hydrology and Water Quality of this report.

It is envisaged that the track formation will consist of a 750 – 1000mm layer of Class 6F2 granular fill, as per TII Series 600 on a geotextile membrane. The construction methodology for newly constructed tracks will be as follows:

- The formation will be prepared to receive geotextile;
- Stone will be placed and compacted in layers ranged between 750 – 1000mm thick;
- For hardstandings, stone thickness (Class 6F2, Series 600) will be upgraded from competent founding level, assumed as the peat depth measured on site, which ranges between 1300mm (T11) and 1700mm (T7). It excludes hardstandings for T8, T9 and T10, which are to be piled;
- A drainage ditch will be formed alongside the tracks;
- Surplus excavated material will be placed along the side of sections of the tracks, around turbines T7, T8, T9, T10, T11, and on the eastern side of the Proposed Substation boundary as per drawings P22-242-0100-0001 to P22-242-0100-0006 and 23727-MWP-00-DR-C-0101. It shall also be dressed to blend in with surrounding landscaping and partially obscure sight of the track.

The following filling and material deposition operations will be required:

- Deposition of surplus Topsoil, Peat and Glacial Till deposits in berms for reinstatement purposes along access tracks, clearfell areas around turbines, and a ”Deposition Area” adjacent to the Proposed Substation as shown in planning drawing 23727-MWP-00-DR-C-0101.
- Importation of General Fill and Engineering Aggregates.

There will be 10.62 km of internal access tracks associated with the Proposed Development site. This will comprise the following:

- 9.67 km of new track construction;
- 0.95 km of existing track upgrade

It is required that all the stone required for the construction of the internal access roads, hardstands, temporary construction compound and the Proposed Substation will be imported from quarries in the vicinity (see Table 9-10: Aggregate and Extraction Volumes for the Proposed Wind Farm). No site or local borrow pits will be used. The reasons for this requirement are the following:

- On-site material is not suitable to achieve the minimum technical requirements for use;
- The expected depth of local bedrock is too deep to be economically and ecologically feasible.

Direct impacts to the existing geological regime associated with the construction of proposed access tracks and hardstands are:

- Soil compaction may occur due to movement of construction traffic. This will occur particularly within areas of highly compressible soft deposits which are left in-situ during the construction phase. This could lead to an increase in surface water runoff due to reduced infiltration of rainfall and subsequently to an increase in erosion of overburden deposits left in-situ.
- The use of plant and machinery during construction will require the storage and use of fuels and oils. Their storage and use present potential for spills and leaks which could contaminate underlying exposed soils.
- During construction, imported engineering fill and excavated soils will be exposed in excavations and in temporary stockpiles. These soils will be subject to erosion by wind and rain which could deposit silt in streams with an indirect impact on surface water quality.

The Magnitude of the impact from these works on the soils and geology receptors is considered to be 'Moderate Adverse' in nature. The importance is considered to be 'Medium'. The rating of these potential impacts, prior to mitigation, is considered to be of **Moderate significance.** The Impact Classification is negative, permanent, direct and will have likely effects.

Direct impacts to the existing hydrogeological regime associated with the construction of proposed access tracks and hardstands are:

- Potential for groundwater pollution from the removal of overburden deposits. The aquifer underlying the Proposed Development site is classified by the GSI as ranging from 'Low' to 'High' vulnerability. The alignment is approximately on the lateral change of these two classifications, corresponding to cut over raised peat to east (low vulnerability) and till or gravels derived from limestone (high vulnerability). Floated roads are proposed for the majority of access tracks, including permanent, temporary and widenings. Therefore, excavations are limited to what is strictly necessary for clearance and levelling;
- The vulnerability of the aquifer to groundwater pollution particularly during construction stage will be increased as some overburden is removed thus reducing the level of protection from groundwater pollution. Ground overburden is expected to be over 20m, as per boreholes published by GSI.

- Potential for silt infiltration to groundwater and discharged in local watercourses as a result of increased surface runoff and reduced protection of the aquifer. Soil erosion as a result of exposure of soils in open excavations and temporary storage of excavated materials represents a potential impact to the underlying groundwater aquifer;
- Potential for groundwater pollution from the use of cement-based compounds during the construction phase.

The Magnitude of the impact from these works on the groundwater receptors is considered to be 'Small Adverse' in nature. The importance is considered to be 'Medium'. The rating of these potential impacts, prior to mitigation, is considered to be of **Slight significance.** The Impact Classification is negative, permanent, direct and will have likely effects.

9.5.3.2. Internal Cabling

The internal cabling will comprise a medium voltage (33kV) internal circuit of buried cables following on-site access tracks.

Connection works will involve the installation of ducting, joint bays, drainage and ancillary infrastructure and the subsequent running of cables along site access tracks. For cable trenches located along access tracks the contractor will excavate cable trenches and then lay high density polyethylene (HDPE) ducting in the trench in a surround of cement bound material (CBM). Cable-ducts will generally be laid when the track is being constructed and will generally follow the edge of the site access tracks. The trenches within these locations will generally be backfilled using the excavated material.

Direct impacts to the existing environment associated with the proposed internal cabling works include:

- Trench excavations and ducting may present a preferential pathway for the movement of groundwater and/or contamination in the subsurface. However, the subsoil at the Proposed Development is predominantly Peat and Till Derived from Limestones, which has low to very low permeability. Besides, the depth of internal cables trench is shallow and impact in groundwater contamination (aquifer vulnerability) may be limited, especially between Turbines T8-T9-T10, where deep peat has been encountered;
- The excavations for the cable trenches and joint bays can have a direct impact on the exposed soils and rock in the form of increased erosion from surface water ingress. It is most likely for trenches where peat is overlying till material, since till material is more permeable, hence there would be a groundwater vulnerability increasement from 'low' to 'high', to South of T6/T7 and to north of T9, where thinner peat layer has been encountered, so till material is more susceptible to be exposed;
- It is not expected that trench excavations will reach rockhead.

The Magnitude of the impact from these works on the soils and geology receptors is considered to be 'Small Adverse' in nature. The importance is considered to be 'Medium'. The rating of these potential impacts, prior to mitigation, is considered to be of **Slight significance.** The Impact Classification is negative, permanent, direct and will have likely effects.

The Magnitude of the impact from these works on the groundwater receptors is considered to be 'Small Adverse' in nature. The importance is considered to be 'Medium'. The rating of these potential impacts, prior to mitigation, is considered to be of **Slight significance.** The Impact Classification is negative, permanent, direct and will have likely effects.

9.5.3.3. Proposed Substation

The Proposed Substation will comprise a loop in loop out substation, which is proposed to connect to an existing overhead 110kV powerline.

The excavations have the potential to give rise to direct permanent impacts on the exposed soils, in the form of increased erosion and sediment release and compaction of peat and soft soils that could also have additional impacts on water quality due to sedimentation of water courses and increased runoff (see Chapter 10 Hydrology and Water Quality). Tree felling and vegetation clearance may also have the potential for similar impacts on the existing soils due to erosion and sediment release.

The following filling and material deposition operations will be required:

- Deposition of surplus Topsoil, Peat and Glacial Till deposits in a ”Deposition Area” for reinstatement purposes adjacent to the Proposed Substation as shown in planning drawing 23727-MWP-00-DR-C-0101.
- Importation of General Fill and Engineering Aggregates.

All the stone required for the construction of the Proposed Substation will be imported from quarries in the vicinity (see Table 9-10). No site or local borrow pits will be used. The reasons for this requirement are the following:

- On-site material is not suitable to achieve the minimum technical requirements for use;
- The expected depth of local bedrock is too deep to be economically and ecologically feasible.

Direct impacts to the existing environment associated with the Proposed Substation include:

- The excavations for foundations, cable trenches and joint bays can have a direct impact on the exposed soils and rock in the form of increased erosion from surface water ingress;
- Excavations and ducting may present a preferential pathway for the movement of groundwater and/or contamination in the subsurface. However, the subsoil at the Substation is predominantly Till Derived From Limestones, which has a low permeability.

The Magnitude of the impact from these works on the soils and geology receptors is considered to be ‘Small Adverse’ in nature. The importance is considered to be ‘Medium’. The rating of these potential impacts, prior to mitigation, is considered to be of **Slight significance.** The Impact Classification is negative, permanent, direct and will have likely effects.

The Magnitude of the impact from these works on the groundwater receptors is considered to be ‘Small Adverse’ in nature. The importance is considered to be ‘Medium’. The rating of these potential impacts, prior to mitigation, is considered to be of **Slight significance.** The Impact Classification is negative, permanent, direct and will have likely effects.

9.5.4. Operational Phase

The potential impacts on soils, geology & hydrogeology from the operation of the Proposed Development are outlined below.

9.5.4.1. Potential Direct Impacts

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

- Some construction traffic may be necessary for maintenance of turbines, hardstands and access tracks which could result in minor accidental leaks or spills of fuel/oil;
- The grid transformer in the Proposed Substation and transformers in each proposed wind turbine will be oil cooled. There is potential for spills / leaks of oils/battery fluids from this equipment resulting in contamination of soils and groundwater.

The Magnitude of the impact from these works on the soils and geology receptors is considered to be 'Small Adverse' in nature. The importance is considered to be 'Medium'. The rating of these potential impacts, prior to mitigation, is considered to be of **Slight significance.** The Impact Classification is negative, short-term, direct and has unlikely effects.

The Magnitude of the impact from these works on the groundwater receptors is considered to be 'Negligible ' in nature. The importance is considered to be 'Medium'. The rating of these potential impacts, prior to mitigation, is considered to be of **Imperceptible.** The Impact Classification is negative, short-term, direct and has unlikely effects.

9.5.4.2. Potential Indirect Impacts

A small amount of granular material may be required to maintain access tracks during operation which will place intermittent minor demand on local quarries listed in **Error! Reference source not found.**.

The Magnitude of the impact from these works on the soils and geology receptors is considered to be 'Small Adverse' in nature. The importance is considered to be 'Medium'. The rating of these potential impacts, prior to mitigation, is considered to be of **Slight Significance.** The Impact Classification is negative, short-term, direct and has unlikely effects.

The Magnitude of the impact from these works on the groundwater receptors is considered to be 'Negligible' in nature. The importance is considered to be 'Medium'. The rating of these potential impacts, prior to mitigation, is considered to be of **Imperceptible.** The Impact Classification is negative, short-term, direct and has unlikely effects.

9.5.5. Potential Impacts during Decommissioning

The potential impacts associated with decommissioning will be similar to those associated with construction but of reduced magnitude.

During decommissioning, it may be possible to reverse or at least reduce some of the impacts caused during construction by rehabilitating construction areas such as turbine bases and hardstanding areas. This will be done by covering with topsoil to encourage vegetation growth and reduce run-off and sedimentation.

Other impacts such as possible soil compaction and contamination by fuel leaks will remain but will be of reduced magnitude. Nevertheless, as noted in the Scottish Natural Heritage guidance on restoration and decommissioning of onshore wind farms (SNH, 2013) reinstatement proposals for a wind farm are made approximately 30 years in advance, so within the lifespan of the wind farm, technological advances and preferred approaches to reinstatement are likely to change.

It is therefore 'best practice not to limit options too far in advance of actual decommissioning but to maintain informed flexibility until close to the end-of-life of the wind farm'.

Ducts and cables will be left in the ground, therefore no potential impacts during decommissioning stage are likely to occur.

The Magnitude of the impact from these works on the soils and geology receptors is considered to be 'Small Adverse' in nature. The importance is considered to be 'Medium'. The rating of these potential impacts, prior to mitigation, is considered to be of **Slight significance.** The Impact Classification is negative, short-term, direct and has unlikely effects.

The Magnitude of the impact from these works on the groundwater receptors is considered to be 'Small Adverse' in nature. The importance is considered to be 'Medium'. The rating of these potential impacts, prior to mitigation, is considered to be of **Slight significance.** The Impact Classification is negative, short-term, direct and has unlikely effects.

9.5.5.1. Potential Cumulative Impacts

As part of the assessment of cumulative impacts, planning searches were undertaken using the following online planning enquiry portals to search for large scale developments within 20km of the site:

- Kildare County Council;
- Meath County Council;
- Offaly County Council;
- An Bord Pleanála.

The following neighbouring wind farms were examined for potential cumulative impacts on soils and geology with the proposed development:

- Cushaling Wind Farm is currently under construction and when complete will comprise a 9-turbine wind farm;
- Ballivor Wind Farm is a consented wind farm development, comprising 26 turbines.

Cloncreen Wind Farm and Yellow River Wind Farm, which have been considered in other chapters of this EIAR, are not considered to act cumulatively with the Proposed Development in terms of soils, geology and hydrogeology as the operational phase of such developments does not present significant risks to these factors. Therefore, these and other operational projects (such as Timahoe Solar Farm) are not considered to act cumulatively with the Proposed Development and are not considered further within this chapter.

Cushaling is located in a separate catchment, so no cumulative hydrological impact is envisaged. However, Ballivor Wind Farm, a granted wind farm development, comprising 26 turbines and is located within the same catchment as the Proposed Development, with drainage from Ballivor and the Proposed Development site both ultimately draining to the River Boyne.

While Ballivor Wind Farm and the Proposed Development have been identified as sharing the same catchment, the two wind farm sites are not connected hydrologically. Both projects are hydrologically connected to the River Boyne but the Boyne is approximately 18 km in-stream distance downstream of the Proposed

Development. Therefore, any potential cumulative effects on hydrology and water quality would be imperceptible.

There are also three solar farm developments, in construction and in planning or pre-planning, in the vicinity of the Proposed Development. The sites are the following:

- Mulgeeth Solar Farm: Adjoining eastern boundary. This project has recently been refused consent for development, but may be appealed;
- Coolcarrigan Solar Farm;
- Dysart Solar Farm.

Other types of proposals near the Proposed Development are listed below:

- Residential developments: large residential developments in Enfield have been integrated into one large project;
- Johnstown Estate Renovations: renovation works are principally to the existing banquet hall and conference centre located to the south of the main hotel building and associated external landscaped areas;
- Restoration of 5 ha of agricultural land: the application relates to a restoration development for the purpose of an activity requiring a Waste Permit to be issued by the Meath County Council;
- Blackwood Equestrian Centre: Proposed two storey stable block;
- Drehid Land Fill Extension: it is proposed to increase the disposal facility at Drehid Waste Management Facility to accept 440,000 tonnes per annum of non-hazardsous waste material;
- Mixed Use Development in Enfield: the development will consist of the construction of a mixed-use development including a 4 storey over ground floor level;
- Royal Oaks Residential Development: it has been proposed construction of 133 no. dwelling units, creche and associated site works;
- 68 residential units in Johnstown Bridge: it has been proposed a development of 59 No houses, 9 No. maisonette apartments, and a retail unit/cafe, with heights ranging from two storeys to two storeys with attic accommodation over.

The potential cumulative impact on land, soils and geology overall is considered to be negligible due to the localised land take with regard to the wind farms and solar farms in the wider area; in relation to peat harvesting, bogs in the area are already degraded and altered so that this does not have an additional impact in terms of lands, soils and geology. Potential cumulative hydrological and water quality impacts have been assessed in Chapters 10 Hydrology and Water Quality of this EIAR.

Table 9-12 below comprises the relevant projects mentioned above and some pertinent information:

Table 9-12: Potential Cumulative Impact from other Developments

Development (Named Developer)	Distance from the Site	Case Number	Status	Interface	Potential Cumulative Impact
Mulgeeth Solar Farm	< 1.0km NE	2460568	Refused (planning Appeal)	Groundwater Subsoils and Bedrock	Negligible to Small Adverse
Coolcarrigan Solar Farm	3.7km SE	2360073	Granted	Groundwater Subsoils and Bedrock	Negligible to Small Adverse
Dysart Solar Farm	2.5km NE	302895	Granted	Groundwater Subsoils and Bedrock	Negligible to Small Adverse
Application for substitute consent in relation to Peat Extraction at Bogs in the Kilbery Bog Group	4.0km E	307284	Granted	Groundwater Subsoils and Bedrock	Negligible to Small Adverse
Proposed development of an extension to an existing Drehid Waste Management Facility	0.5km S	317292	Granted	Groundwater Subsoils and Bedrock	Negligible to Small Adverse
Cushaling Wind Farm comprising 9 no. Wind Turbines and all associated works	10.2km SW	317245	Under construction	Groundwater Subsoils and Bedrock	Negligible to Small Adverse

Development (Named Developer)	Distance from the Site	Case Number	Status	Interface	Potential Cumulative Impact
Ballivor Wind Farm comprising up to 26 no. Wind Turbines and all associated works	18.0km N	316212	Granted	Groundwater Subsoils and Bedrock	Negligible to Small Adverse
A number of residential developments	2.8km N	21/1449 21/1461 21/1462 23/272	Granted	Groundwater Subsoils and Bedrock	Negligible to Small Adverse
Johnstown Estate Renovations	2.0km N	Kildare planning reference 23/613	Granted	Groundwater Subsoils and Bedrock	Negligible to Small Adverse
Restoration of 5 ha of agricultural land	3.2km N	Meath planning reference TA200121	Granted	Groundwater Subsoils and Bedrock	Negligible to Small Adverse
Blackwood Equestrian Centre	2.5km SE	Kildare planning reference 191031	Granted	Groundwater Subsoils and Bedrock	Negligible to Small Adverse
Royal Oaks Residential Development	3.9km N	Meath planning reference 2492	Granted	Groundwater Subsoils and Bedrock	Negligible to Small Adverse
68 residential units in Johnstown Bridge	1.8km N	Kildare planning reference 22488	Granted	Groundwater Subsoils and Bedrock	Negligible to Small Adverse

The Proposed Developments summarised in Table 9-12 have been granted, excluding Mulgeeth Solar Farm, which has been refused although an appeal may be pending. While some have already been constructed and are now operational, if construction for the other projects overlap or run concurrently with the Proposed Development, there may be a supply issue with local quarries providing imported aggregate.

The magnitude of the impact from these works on the soils and bedrock receptors is considered to be 'Small Adverse' in nature. The importance is considered to be 'Medium'. The rating of this potential cumulative impact is considered to be of **Slight significance.** The Impact Classification is negative, short-term, indirect and has unlikely effects.

There is the potential for groundwater pollution from run-off impacting on the groundwater receptor from the development sites. The Magnitude of the impact from these works on the groundwater receptors is considered to be 'Negligible' in nature. The importance is considered to be 'Medium'. The rating of this potential cumulative impact is considered to be of **Imperceptible significance.** The Impact Classification is negative, short-term, indirect and has unlikely effects.

9.5.5.2. Summary of Potential Cumulative Impacts

During the construction of the Proposed Development there will be the requirement for the importation of engineered fill from licenced quarries. Should these coincide with demand for imported aggregate for construction works at other development locations there would a cumulative impact in terms of demands placed on local quarries for aggregate.

As such, it is considered there may be a **Slight** cumulative impact during construction stage.

No significant, negative cumulative effects are envisaged during the operation or decommissioning phase of the Proposed Development. As such no mitigation measures are required with respect to potential cumulative impacts.

9.5.6. Summary of Potential Impacts

A summary of unmitigated potential impacts on soils, geology & hydrogeology attributes from the Proposed Development is provided in Table 9-13 with the potential impacts on hydrogeological attributes provided in Table 9-14.

Table 9-13: Summary of Potential Unmitigated Impact Significance of Proposed Development on Geological Receptors

Activity	Potential Impact	Receptor	Importance	Prior to Mitigation	
				Magnitude	Significance
Construction Phase					
Earthworks associated with the construction of the proposed turbines and associated infrastructure.	Removal of overburden material, open excavations and subsequent exposure of more permeable underlying overburden leading to increased erosion. Construction traffic resulting in soil compaction and increase in surface water runoff resulting in increased erosion of exposed soils. Importation of engineering fill and concrete.	Peat and Till/Gravel Derived From Limestones	Medium	Small Adverse	Slight
Earthworks associated with the construction of the proposed turbines and associated infrastructure.	Slope Failure.	Peat and Till/ Gravel Derived From Limestones	Medium	Moderate Adverse	Moderate

Activity	Potential Impact	Receptor	Importance	Prior to Mitigation	
				Magnitude	Significance
Earthworks associated with the construction of the Proposed Substation.	Removal of overburden material, open excavations and subsequent exposure underlying overburden leading to increased erosion. Construction traffic resulting soil compaction and increase in surface water runoff resulting in increased erosion of exposed soils. Importation of engineering fill and concrete.	Peat and Till/ Gravel Derived From Limestones	Medium	Small Adverse	Slight
Construction of Internal Site Access Tracks, Hardstands, Temporary Compound, and related berms and clearfell areas.	Open excavations, increased runoff causing erosion of underlying overburden. Construction traffic resulting soil compaction and increase in surface water runoff resulting in increased erosion of exposed soils. Importation of engineering fill.	Peat and Till/ Gravel Derived From Limestones Local quarries.	Medium	Moderate Adverse	Moderate
Construction of Internal Cabling.	Removal of overburden material and exposure of underlying subsoil to erosion. Importation of engineering fill and concrete products. Local storage with landscaping to minimize environmental and visual impact.	Peat and Till/ Gravel Derived From Limestones. Local quarries.	Medium	Small Adverse	Slight

Activity	Potential Impact	Receptor	Importance	Prior to Mitigation	
				Magnitude	Significance
Construction of the Proposed Substation.	Removal of overburden material and exposure of underlying subsoil to erosion. Construction traffic resulting soil compaction and increase in surface water runoff resulting in increased erosion of exposed soils. Importation of engineering fill and concrete products. Local storage with landscaping to minimize environmental and visual impact.	Peat and Till/ Gravel Derived From Limestones. Local quarries.	Medium	Small Adverse	Slight
Operational Phase					
Construction traffic for maintenance of turbines, hardstands and access tracks. Operation of substation and turbines.	Release of hydrocarbons or fuel spill. Increase in rate of run-off causing erosion. Potential for localized soil contamination from traffic and substation equipment.	Peat and Till/ Gravel Derived From Limestones. Groundwater Aquifer and SPZ.	Medium	Small Adverse	Slight

Activity	Potential Impact	Receptor	Importance	Prior to Mitigation	
				Magnitude	Significance
Maintenance of access tracks.	Importation of engineering fill. Positive impact of reduced rate of run-off and sedimentation. Potential for contamination from machinery or imported soils and soil compaction from machinery.	Local quarries. Peat and Till/ Gravel Derived From Limestones. Groundwater Aquifer and SPZ.	Medium	Small Adverse	Slight
Decommissioning Phase					
Removal of Turbines and Hardstands.	Construction traffic resulting in soil compaction and increase in surface water runoff resulting in increased erosion of exposed soils.	Peat and Till/ Gravel Derived From Limestones. Groundwater Aquifer and SPZ.	Medium	Small Adverse	Slight
Cumulative Impacts					
Large-scale developments within 20km of the Site occurring concurrently with construction of the Proposed Development.	Cumulative impacts on local quarries from extraction of fill for Proposed Development.	Local quarries	Medium	Small Adverse	Slight

Activity	Potential Impact	Receptor	Importance	Prior to Mitigation	
				Magnitude	Significance
Vegetation Clearance	Exposure of underlying overburden leading to increased erosion. Felling machinery resulting soil compaction of soft deposits and an increase in surface water runoff resulting in increased erosion of exposed soils.	Peat and Till/ Gravel Derived From Limestones.	Medium	Small Adverse	Slight
Enabling TDR Works	Removal of overburden material and exposure of underlying subsoil to erosion. Construction traffic resulting soil compaction and increase in surface water runoff resulting in increased erosion of exposed soils.	Subsoils. Local quarries.	Medium	Small Adverse	Slight

Table 9-14: Summary of Potential Unmitigated Impact Significance of Proposed Development on Hydrogeological Receptors

Activity	Potential Impact	Receptor	Sensitivity	Prior to Mitigation	
				Magnitude	Significance
Construction Phase					
Earthworks associated with the construction of the proposed turbines and associated infrastructure.	Potential for groundwater pollution from the removal of overburden deposits. Potential for silt infiltration to local watercourses and groundwater as a result of increased surface runoff and reduced protection of the aquifer. Potential for contamination to groundwater from spills/leakages during construction phase earthworks. Reduction in groundwater levels from dewatering of excavation as required during the construction phase.	Locally Important Bedrock Aquifer. Groundwater Wells.	Medium	Moderate Adverse	Moderate

Activity	Potential Impact	Receptor	Sensitivity	Prior to Mitigation	
				Magnitude	Significance
Earthworks associated with the construction of the proposed turbines and associated infrastructure.	Slope Failure.	Locally Important Bedrock Aquifer. Groundwater Wells.	Medium	Small Adverse	Slight
Earthworks associated with the construction of the Proposed Substation.	Potential for groundwater pollution from the removal of overburden deposits. Potential for silt infiltration to local watercourses and groundwater as a result of increased surface runoff and reduced protection of the aquifer. Potential for contamination to groundwater from spills/leakages during construction phase earthworks. Reduction in groundwater levels from dewatering of excavation as required during the construction phase.	Locally Important Bedrock Aquifer. Groundwater Wells.	Medium	Small Adverse	Slight

Activity	Potential Impact	Receptor	Sensitivity	Prior to Mitigation	
				Magnitude	Significance
Construction of Internal Site Access Tracks, Hardstands and Temporary Compound.	Potential for groundwater pollution from the removal of overburden deposits. Potential for silt infiltration to groundwater as a result of increased surface runoff and reduced protection of the aquifer. Potential for contamination to groundwater from spills/leakages during construction phase earthworks. Potential for ground water pollution from the use of cement-based compounds during the construction phase.	Locally Important Bedrock Aquifer. Groundwater Wells.	Medium	Small Adverse	Slight

Activity	Potential Impact	Receptor	Sensitivity	Prior to Mitigation	
				Magnitude	Significance
Construction of the Proposed Substation.	Potential for groundwater pollution from the removal of overburden deposits. Potential for silt infiltration to groundwater and discharge to local watercourses as a result of increased surface runoff and reduced protection of the aquifer. Potential for contamination to groundwater from spills/leakages during construction phase earthworks. Potential for ground water pollution from the use of cement-based compounds during the construction phase.	Locally Important Bedrock Aquifer. Groundwater Wells.	Medium	Small Adverse	Slight

Activity	Potential Impact	Receptor	Sensitivity	Prior to Mitigation	
				Magnitude	Significance
Construction of Turbine Foundations.	Potential for silt infiltration to groundwater as a result of increased surface runoff and reduced protection of the aquifer. Potential for contamination to groundwater from spills/leakages during construction phase earthworks. Potential for ground water pollution from the use of cement-based compounds during the construction phase. Reduction in groundwater levels from dewatering of excavation as required during the construction phase.	Locally Important Bedrock Aquifer. Groundwater Wells.	Medium	Small Adverse	Slight

Activity	Potential Impact	Receptor	Sensitivity	Prior to Mitigation	
				Magnitude	Significance
Construction of Proposed Substation Foundations.	Potential for silt infiltration to groundwater as a result of increased surface runoff and reduced protection of the aquifer. Potential for contamination to groundwater from spills/leakages during construction phase earthworks. Potential for ground water pollution from the use of cement-based compounds during the construction phase. Reduction in groundwater levels from dewatering of excavation as required during the construction phase.	Locally Important Bedrock Aquifer. Groundwater Wells.	Medium	Small Adverse	Slight

Activity	Potential Impact	Receptor	Sensitivity	Prior to Mitigation	
				Magnitude	Significance
Construction of Internal Cabling.	Potential for ground water pollution from the removal of overburden deposits. Potential for silt infiltration to groundwater as a result of increased surface runoff and reduced protection of the aquifer. Potential for contamination to groundwater from spills/leakages during construction phase earthworks.	Locally Important Bedrock Aquifers. Groundwater Wells.	Medium	Small Adverse	Slight

Activity	Potential Impact	Receptor	Sensitivity	Prior to Mitigation	
				Magnitude	Significance
Construction of cabling for the Proposed Substation.	Potential for ground water pollution from the removal of overburden deposits. Potential for silt infiltration to groundwater as a result of increased surface runoff and reduced protection of the aquifer. Potential for contamination to groundwater from spills/leakages during construction phase earthworks.	Locally Important Bedrock Aquifers. Groundwater Wells.	Medium	Small Adverse	Slight
Operational Phase					

Activity	Potential Impact	Receptor	Sensitivity	Prior to Mitigation	
				Magnitude	Significance
Operational traffic, refueling of vehicles.	Some operational traffic will be necessary for maintenance plus normal operational traffic which could result in minor accidental leaks or spills of fuel/oil.	Locally Important Bedrock Aquifer. Groundwater Wells.	Medium	Small Adverse	Slight
Decommissioning Phase					

Activity	Potential Impact	Receptor	Sensitivity	Prior to Mitigation	
				Magnitude	Significance
Removal of Turbines and Hardstands.	Potential for groundwater pollution from the disturbance of overburden deposits. Potential for silt infiltration to groundwater as a result of increased surface runoff and reduced protection of the aquifer. Potential for contamination to groundwater from spills/leakages during decommissioning phase earthworks.	Locally Important Bedrock Aquifer. Groundwater Wells.	Medium	Small Adverse	Slight
Cumulative Impacts					
Large-scale developments within 20km of the Proposed Development Site occurring concurrently with construction of the Site	Potential for groundwater pollution from runoff.	Potential cumulative impact on: Locally Important Bedrock Aquifer. Groundwater Wells.	Medium	Negligible	Imperceptible

Activity	Potential Impact	Receptor	Sensitivity	Prior to Mitigation	
				Magnitude	Significance
Vegetation Clearance	Potential for silt infiltration to groundwater as a result of increased surface runoff and reduced protection of the aquifer. Potential for contamination to groundwater from spills/leakages from felling machinery.	Locally Important Bedrock Aquifer. Groundwater Wells.	Medium	Small Adverse	Slight
Enabling TDR Works	Removal of overburden material and exposure of underlying subsoil to erosion. Construction traffic resulting soil compaction and increase in surface water runoff resulting in increased erosion of exposed soils.	Locally Important Bedrock Aquifers. Groundwater Wells.	Medium	Small Adverse	Slight

9.6. Mitigation Measures

The following section outlines appropriate mitigation measures by design and best practice to avoid or reduce the potential impact of the Proposed Development.

9.6.1. Mitigation by Design and Best Practice

In order to reduce the impacts on geology, hydrogeology and slope stability, infrastructure has been primarily located within areas of thinner soft ground and lower slope gradients. Extensive work has already been undertaken at the preliminary design stage to apply risk avoidance by design which included:

- Peat probing and site walkover surveys to identify geotechnical constraints (e.g. peat deposits and evidence of historic landslip) likely to adversely affect the design of the Proposed Development site;
- Relocation and micro-siting of turbines, hardstandings, substation and access roads based on the site assessments and geotechnical assessments in order to reduce ground risk associated with the Proposed Development;
- The works have been designed and checked by geotechnical and civil engineers, who are suitably qualified and experienced in excavation and earthworks design and construction methodologies. A discussion about the site and the alternatives selected is included in Chapter 2 of this EIAR.

The following will also be implemented:

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

9.6.2. Construction Phase

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

9.6.2.1. Construction Environmental Management Plan (CEMP)

A Construction Environmental Management Plan (CEMP) has been prepared for the Proposed Development and is included in Volume 3, Appendix 3.2. The CEMP defines the work practices, environmental management procedures and management responsibilities relating to the construction phase of the Proposed Development.

The CEMP sets out the key environmental management measures associated with the construction, operation and decommissioning of the site, to ensure that during these phases of the development, the environment is protected, and any potential impacts are minimised. The final CEMP will be developed further at the construction stage, on the appointment of the main contractor to the development to address the requirements

of any relevant planning conditions, including any additional mitigation measures that are conditioned and shall be submitted to the planning authority.

Reference to relevant sections of the CEMP with respect to the mitigation of potential impacts to Soils, Geology and Hydrogeology from the Proposed Development are outlined below.

9.6.2.2. Earthworks

The Proposed Development will be constructed in a phased manner to reduce the potential impacts on the Soils, Geology and Hydrogeology. Phased construction reduces the amount of open, exposed excavations at any one time. Given that the works comprises a significant proportion of excavation and earthworks, suitably qualified and experienced geotechnical personnel will be required on site to supervise the works.

Details of the proposed methodology and mitigation measures are summarised below and are also outlined in in the CEMP in Appendix 3.2 of Volume 3.

One of the primary mitigation measures employed at the preliminary design stage was the minimisation of earthworks volumes as follows:

- All excavated overburden will be retained on-site. The surplus that cannot be used as backfill material will be stored in berms along access tracks and clearfell areas around Turbines T8, T9, T10 and T11, which are designed for that purpose. Permanent storage areas will be landscaped to minimize erosion and visual impact (see drawings P22-242-0100-0002 to P22-242-0100-0006);
- All the access tracks will be floated, excluding the entrance from public road to T1 (0.4m of average excavation depth) and the track in the agricultural land leading up to the loop-in/loop-out connection (0.3m of average excavation depth);
- Turbines T8, T9 and T10 and related hardstands will be piled;
- No borrow pits will be used and all fill and aggregate will be imported from local quarries.

Surplus overburden deposits excavated during the course of the works will be temporarily stored in a level area adjacent to the construction phase excavations prior to reuse as backfill or store in the above-mentioned berms and clearfell areas.

Some temporary stockpiles (not exceeding 2m in height) of material will be necessary adjacent to the excavation areas prior to reinstatement, however no long-term stockpiles of material will remain after construction and no surplus/waste soil or rock will be removed from the Proposed Development site. Temporary stockpiles will be shaped and sealed to prevent the ingress of water from rainfall and placed away from open excavations, sloping / soft ground as not to create an instability risk during temporary works.

To mitigate against the compaction of soil at the site, prior to the commencement of any earthworks, the work corridor will be pegged, and machinery will stay within this corridor so that soils outside the work area are not damaged. Excavations will then be carried out from access tracks as they are constructed in order to reduce the compaction of soft ground.

To mitigate against erosion of the exposed soil, all excavations will be constructed and backfilled as quickly as possible. Excavations will stop during or prior to heavy rainfall events (>10mm/hour). To mitigate against possible contamination of the exposed underlying soils, refuelling of machinery and plant will only occur at designated refuelling areas.

All temporary cuts/excavations will be carried out such that they are stable or adequately supported. Gravel fill will be used to provide additional support to drains where appropriate. Where appropriate and necessary, temporary cuts and excavations will be protected against the ingress of water or erosion by covering during adverse weather. Where necessary sheet piling or other measures will be used to provide integrity for unstable excavations, particularly within peat, alluvial, gravel or for excavations below the water table.

Support may also be required to support elevated floating roads which are being excavated for the installation of cable trenches. The stability of all excavations will be assessed in advance by an experienced geotechnical engineer. Temporary works will be such that they do not adversely interfere with existing drainage channels/regimes by the provision of silt traps and silt fencing as required (refer to Chapter 10 – Hydrology and Water Quality).

The proposed turbine locations have been carefully selected in areas of the site which is relatively close to the existing access tracks to minimise the length of new access tracks required. Drainage will be towards the existing drainage network.

Any contaminated soils will be handled, removed and disposed of in accordance with the requirements of the local authority and/or EPA and waste management legislation. In particular, the following measures will be implemented:

- Contaminated material will be left in-situ and covered, where possible until such time as the classification and assessment of waste at the site is undertaken in accordance with the appropriate technical guidance;
- Prior to removal of material from site for disposal WAC (Waste Acceptance Criteria) testing should also be undertaken in accordance with recommended standards and in-line with the acceptance criteria at a suitably licenced landfill or treatment facility;
- Where materials are removed from site for disposal, materials will be transported by a contractor with a valid waste collection permit and recovered/disposed of at an appropriately licensed facility.

Unregulated drainage will not be permitted within the Proposed Development. Any pumping of excavations will be directed into existing drainage networks via settlement ponds and will not be allowed to discharge directly to the ground except under licence.

All fuel and liquids will be stored on site in fully bunded areas as described in detail in Chapter 10 – Hydrology and Water Quality of the EIAR. In addition, an effluent holding tank along with other protection measures will be used at the substation in order to protect the Source Protection Zone at Drehid and prevent any discharges to ground. These are detailed in Chapter 10, Hydrology and Water Quality.

Other mitigation measures relating to soils and geology include the following:

- Internal Haul roads will be capped as soon as practicably possible to cover exposed subsoils and as such reduce the concentration of suspended solids in the run-off;
- A suitably qualified person will be appointed by the developer to ensure the effective operation and maintenance of drainage and other mitigation measures during the construction process;
- Due to the dispersed nature of the site, refuelling of plant during construction will be carried out at a number of dedicated refuelling station locations on site, typically at each compound or at least 100m from a watercourse using mobile bowsers;

- Each station will be fully equipped for a spill response and a specially trained and dedicated environmental and emergency spill response team will be appointed before commencement on site. Drip trays and spill kits will be kept available on site, to ensure that any spills from the vehicle are contained and removed off site. Only emergency breakdown maintenance will be carried out on site and appropriate containment facilities will be provided to ensure that any spills from breakdown maintenance vehicles are contained and removed off site;
- Portaloos and/ or containerised toilets and welfare units will be used to provide toilet facilities for site personnel during construction. Sanitary waste will be removed from site via a permitted waste contractor.

9.6.2.3. Control of Sediment Laden Runoff

The potential impact from silt laden surface water runoff from increased erosion of exposed overburden deposits will be addressed particularly at drainage locations and where earthworks and vegetation clearance are proposed.

Details of the proposed Surface Water Management System and mitigation measures is summarised below and are also outlined in the CEMP in Appendix 3.2 of Volume 2.

Best practices will be employed in the prevention of silt laden run-off from entering watercourses as discussed below.

To minimise the impact to surface water quality, existing forestry drainage will be maintained outside the immediate site area, and where appropriate, additional site drainage and settlement ponds will be installed as required prior to construction activities. Silt fencing will be installed in new drainage and monitoring of water quality undertaken during the construction phase.

Final drainage will be constructed following the completion of these activities with silt fencing maintained until such time as a vegetation cover has become established. Chapter 10 of this EIAR discusses surface water issues in more detail.

9.6.2.4. Measures for Spills

Details of oil spill protection measures adjacent to sensitive receptors and emergency spill response procedures are outlined in the CEMP which is contained in Appendix 3.2 of Volume 2.

Storage tanks, used to store fuel for the various items of machinery, will be self-contained and double-walled. Refuelling of construction vehicles will be carried out from these tanks or from delivery vehicles at designated refuelling areas. Specific mitigation measures relating to the management of hydrocarbons are as follows:

- Fuels, lubricants and hydraulic fluids for equipment used on the construction site will be carefully handled to avoid spillage.
- Any spillage of fuels, lubricants or hydraulic oils will be immediately contained, and the contaminated soil removed from the site and properly disposed of;
- Waste oils and hydraulic fluids will be collected in leak-proof containers and removed from the Proposed Development site for disposal or re-cycling; and
- Appropriate spill control equipment, such as oil soakage pads, will be kept within the construction area and in each item of plant to deal with any accidental spillage.

9.6.2.5. Slope Stability

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

- The works will be supervised by a suitably qualified and experienced geotechnical engineer or engineering geologist, and hydrologist or drainage engineer;
- No amendments to the designed works will be made without the prior approval of a suitably qualified and experienced engineering geologist or geotechnical engineer familiar with wind farm construction works;
- Identified risks will be minimised by the application of the principles of avoidance, prevention and protection. Information on risks are outlined in the CEMP. This will be reviewed and updated prior to commencement of construction;
- A detailed method statement for each element of the works will be prepared prior to any element of the work being carried out. An outline of the methods are given in the CEMP. This will be reviewed and updated prior to commencement of construction;
- Details of the relevant assumptions, relating to methods and sequencing of work are provided in the CEMP. This will be reviewed and updated prior to commencement of construction;
- A CEMP has been submitted with this EIAR. Prior to construction, a site-specific environmental management plan for construction will be prepared, which will incorporate all measures set out in the CEMP, in consultation with the relevant statutory bodies, including the planning authority, Waterways Ireland and the NPWS;
- The environmental management plan for construction will provide for the checking by suitably qualified and experienced staff of equipment, materials storage and materials transfer areas, as well as drainage structures and their attenuation ability, on a regular basis;
- An emergency plan will be updated at pre-construction stage detailing the action plan which would be implemented in the unlikely event of a landslide/slope failure. Should a landslide/slope failure occur or if signs of instability/ground movement are observed, work will cease immediately;
- Drainage infrastructure will be put in place in advance of excavations. Drains will divert surface water and groundwater away from excavations into the existing and proposed surface drainage network. Uncontrolled, direct and concentrated discharges of water onto the ground surface will be avoided;
- Loading or stockpiling of materials on the surface of soft ground will be avoided. Loading or stockpiling on other deposits will not be undertaken without first establishing the adequacy of the ground to support loads by an appropriately qualified geotechnical engineer experienced in construction within upland conditions. No stockpiling of material shall take place on steep slopes;
- Excavation will be carried out from access roads or hardstanding areas to avoid tracking of construction plant across areas of soft ground;
- Excavations which could have the potential to undermine the up-slope component of an existing slope will be sufficiently supported to resist lateral slippage and careful attention will be given to the existing drainage;
- Earthworks will not be commenced when heavy or sustained rainfall (orange or red weather warnings) is forecast. A series of rainfall gauges will be installed across the Proposed Development site to provide a record of rainfall intensity. An inspection of site stability and drainage by the Geotechnical Engineer will be carried out on site when a daily rainfall of over 10mm/hr or 25mm/day is recorded on site, works will only recommence after heavy rain with the prior approval of the Geotechnical Engineer following their inspection.

Further details are given in the CEMP included in Appendix 3.2 of Volume 2 of this EIAR.

9.6.2.6. Groundwater

To mitigate against the increased vulnerability of the underlying aquifer to groundwater pollution, all excavations will be constructed and backfilled as quickly as possible. Excavations will stop during or prior to heavy rainfall events. To mitigate against possible contamination of the underlying groundwater, refuelling of machinery and plant will only occur at designated refuelling areas. Details of mitigation measures related to spills and fuel storage are outlined above.

Excavations dewatering are not expected to cause major interference with GSI recorded or domestic wells in the area. This is because deep rockhead is expected in the site. Besides, local quaternary bodies are expected to be peat overlying till with low permeability.

Finally, no deep excavations are planned to be performed with exception of turbine foundation excavations, which are to be no greater than 3m deep in piled solution for turbines T8, T9 and T10. A piled solution is proposed for hardstands in deep peat areas and floated roads are proposed for access tracks and temporary compounds, and as such there is no need of significant excavation for these elements. Less than one metre of average excavation expected for the Proposed Substation as it has been located in an area of shallow peat. In the case of water inflow pumping is required, it is expected to be for short-time term and with limited inflow rate. Therefore, proximal wells are expected to have quick water level recovery to normal.

The GSI database is however not complete; it is probable that there are other wells in addition to those in the GSI databases, but are generally associated with houses. It is conservatively assumed in this assessment that there is a well present in every household within 1km of the site boundary. Given the limited depth of the excavations during the construction phase and the distance to sensitive groundwater receptors the potential risk posed to groundwater supply wells is considered to be Imperceptible following the implementation of mitigation measures discussed above.

If, however, in the exceedingly unlikely event of a previously unknown domestic well being impacted by the Proposed Development, an alternative supply will be provided – either a connection to mains water or a replacement well will be drilled.

Depending on the ground conditions, presence of services, traffic management required, weather conditions, etc., the rate of installation of cable ducting would be circa 100m per day. Dewatering is therefore unlikely to be required and no impacts on wells is envisaged.

The internal cable trenches could provide preferential pathways for groundwater and contaminant movement. Trenches will be excavated during dry periods in short sections (of approximately 50m – 100m) and left open for minimal periods, to avoid acting as a conduit for surface water flows. No excavations will be carried out in heavy rainfall. To further mitigate the risk of cable trenches becoming preferential pathways, clay plugs (or other low permeability material) will be installed at regular intervals along the trench to stop / inhibit water movement.

9.6.3. Mitigation Measures during Operation

It is not envisaged that the operation of the Proposed Development will result in significant impacts on the geological and hydrogeological regimes within the study area, as there will be no further disturbance of overburden post-construction.

There is a low risk to the geology receptors from compaction of soils due to the movement of HGVs and maintenance vehicles. All site traffic will be limited to access tracks, thereby reducing the area over which compaction of the underlying natural soils can occur.

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

- Fuels, lubricants and hydraulic fluids for equipment used on the site will be carefully handled to avoid spillage.
- Any spillage of fuels, lubricants or hydraulic oils will be immediately contained, and the contaminated soil removed from the site and properly disposed of;
- Waste oils and hydraulic fluids will be collected in leak-proof containers and removed from the site for disposal or re-cycling; and
- Appropriate spill control equipment, such as oil soakage pads, will be kept within the refuelling areas and in each item of plant to deal with any accidental spillage.

Due to the reduced magnitude of the impacts, no additional mitigation measures are required for the maintenance and operation of the Proposed Development site, over and above those incorporated into the design of the substation transformer, which will be bunded to protect soils against accidental leakages of oils and battery fluids.

9.6.4. Mitigation Measures during Decommissioning

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

Some of the impacts associated with reinstatement of the site (excavation of turbine bases, access tracks etc.) will be avoided by leaving these in place where possible. The Irish Wind Energy Association (IWEA) (2012) states that when decommissioning a wind farm "*the concrete bases could be removed, but it may be better to leave them under the ground, as this causes less disturbance*". It is proposed to leave the access tracks in-situ at the decommissioning stage. IWEA also state that "*it may be best*" to leave site tracks in-situ depending on the size and geography of the development.

It is considered that leaving the turbine foundations, access tracks and hardstanding areas in-situ will cause less environmental damage than removing and recycling them. It is proposed to retain these elements of the construction. Turbine bases will be covered with overburden material to allow for re-vegetation of the Proposed Development site. It is proposed that the internal site access tracks and hard standings will be left in place and the land reinstated at these locations. The electrical infrastructure including substations and ancillary electrical equipment shall form part of the national grid and will be left in-situ.

Removal of this infrastructure would result in considerable disruption to the local environment in terms of increased sedimentation, erosion, dust, noise, traffic and an increased possibility of contamination of the local water table. However, if removal is deemed to be required by the respective local authority all infrastructure will be removed with mitigation measures similar to those during construction being employed.

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

9.7. Residual Impacts

9.7.1. Residual Impacts of the Proposed Development

Residual impacts that are most likely to occur at the Proposed Development during the construction phase are as follows:

- There will be a change in ground conditions at the site with the replacement of natural materials such as glacial deposits and peat by concrete, sub-grade and surfacing materials. This is a direct permanent change to the material composition of the site.

Residual impacts that are most likely to occur at the Proposed Development during the Operational phase would be as follows:

- Changes in ground surfacing including areas of new hardstands will impact on the hydrology of the site and may result in increased runoff of rainwater and increased drainage discharge. It is anticipated that this should not have a major impact upon the hydrology of the site.
- The drainage infrastructure that will be emplaced as part of the roads and turbines development will also change the sub-surface hydrology by replacing some manmade drainage systems with line interceptors and point discharges to buffered outfalls. Careful design of this drainage to mimic natural conditions will help to mitigate negative impacts of artificial drainage.

Residual impacts for decommissioning are not expected to be significant and no specific impacts are identified for this stage apart of the turbines removal.

The residual impact is summarized in Table 9-15 and Table 9-16 using the impact assessment methodology outlined above in Section 9.2 and taking account of mitigation measures in Section 9.6 of this document.

It can be observed from Table 9-15 and Table 9-16 that, following the implementation of mitigation measures, the residual impact significance to the receiving environment would be slight to imperceptible during the construction period and imperceptible in all respects assessed during the operation of the wind farm. Mitigation measures will be monitored throughout the construction and operational phases.

Mitigation systems will, where required, be in place before development works commence.

As a result of the mitigation measures to be applied, the wind farm is expected to have a low impact on the receiving environment.

The Proposed Development is not expected to contribute to any significant, negative cumulative effects of other existing developments in the vicinity. When the mitigation measures are implemented in full, any effects on the receiving environment will be of imperceptible significance.

Table 9-15: Residual Impact Significance for Sensitive Geological Attributes

Activity	Potential Impact	Receptor	Sensitivity	Prior to Mitigation		After Mitigation	
				Magnitude	Significance	Magnitude	Significance
Construction Phase							
Earthworks associated with the construction of the proposed turbines and associated development	Removal of overburden material, open excavations and subsequent exposure underlying overburden leading to increased erosion. Construction traffic resulting in soil compaction and increase in surface water runoff resulting in increased erosion of exposed soils. Importation of engineering fill and concrete.	Localised organic soils and Glacial Till deposits. Groundwater Aquifer and SPZ.	Medium	Small Adverse	Slight	Negligible	Imperceptible
Earthworks associated with the construction of the proposed turbines and associated development.	Slope Failure.	Localised organic soils and Glacial Till deposits.	Medium	Moderate Adverse	Moderate	Negligible	Imperceptible

Activity	Potential Impact	Receptor	Sensitivity	Prior to Mitigation		After Mitigation	
				Magnitude	Significance	Magnitude	Significance
Earthworks associated with the construction of the Proposed Substation.	Removal of overburden material, open excavations and subsequent exposure underlying overburden and bedrock leading to increased erosion. Construction traffic resulting soil compaction and increase in surface water runoff resulting in increased erosion of exposed soils. Importation of engineering fill and concrete.	Localised organic soils, Glacial Till deposits and bedrock.	Medium	Small Adverse	Slight	Negligible	Imperceptible
Construction of Internal Site Access Tracks, Hardstands and Temporary Compound.	Open excavations, increased runoff causing erosion of underlying overburden and bedrock. Construction traffic resulting soil compaction and increase in surface water runoff resulting in increased erosion of exposed soils. Importation of engineering fill.	Localised organic soils and Glacial Till deposits.	Medium	Moderate Adverse	Moderate	Negligible	Imperceptible

Activity	Potential Impact	Receptor	Sensitivity	Prior to Mitigation		After Mitigation	
				Magnitude	Significance	Magnitude	Significance
Construction of the Proposed Substation.	Open excavations, increased runoff causing erosion of underlying overburden and bedrock. Construction traffic resulting soil compaction and increase in surface water runoff resulting in increased erosion of exposed soils. Importation of engineering fill.	Localised organic soils and Glacial Till.	Medium	Small Adverse	Slight	Negligible	Imperceptible
Construction of Internal Cabling.	Removal of overburden material and exposure of underlying subsoil to erosion. Construction traffic resulting soil compaction and increase in surface water runoff resulting in increased erosion of exposed soils. Importation of engineering fill and concrete products. Permanent surplus local storage at designated areas with landscaping to minimize environmental and visual impact.	Localised organic soils and Glacial Till deposits.	Medium	Small Adverse	Slight	Negligible	Imperceptible

Activity	Potential Impact	Receptor	Sensitivity	Prior to Mitigation		After Mitigation	
				Magnitude	Significance	Magnitude	Significance
Construction of cabling for the Proposed Substation.	Removal of overburden material and exposure of underlying subsoil. Importation of engineering fill and concrete products. Permanent surplus local storage at designated areas with landscaping to minimize environmental and visual impact.	Localised organic soils and Glacial Till deposits.	Medium	Small Adverse	Slight	Negligible	Imperceptible
Operational Phase							
Construction traffic for maintenance of turbines, hardstands and access tracks. Operation of the Proposed Substation and turbines.	Release of hydrocarbons or fuel spill.	Localised organic soils and Glacial Till deposits.	Medium	Small Adverse	Slight	Negligible	Imperceptible
Maintenance of access tracks.	Importation of engineering fill.	Local quarries.	Medium	Small Adverse	Slight	Negligible	Imperceptible
Decommissioning Phase							

Activity	Potential Impact	Receptor	Sensitivity	Prior to Mitigation		After Mitigation	
				Magnitude	Significance	Magnitude	Significance
Removal of Turbines and Hardstands.	Construction traffic resulting soil compaction and increase in surface water runoff resulting in increased erosion of exposed soils.	Localised organic soils and Glacial Till deposits.	Medium	Small Adverse	Slight	Negligible	Imperceptible
Cumulative Impacts							
Large-scale developments within 20km of the Site occurring concurrently with construction of Proposed Development.	Cumulative impacts on local quarries from extraction of fill for Proposed Development.	Local quarries.	Medium	Small Adverse	Slight	-	-

Activity	Potential Impact	Receptor	Sensitivity	Prior to Mitigation		After Mitigation	
				Magnitude	Significance	Magnitude	Significance
Vegetation Clearance	Exposure of underlying overburden leading to increased erosion. Felling machinery resulting soil compaction of soft deposits and an increase in surface water runoff resulting in increased erosion of exposed soils.	Localised organic soils and Glacial Till deposits.	Medium	Small Adverse	Slight	-	-
Enabling TDR Works	Removal of overburden material and exposure of underlying subsoil and bedrock to erosion. Construction traffic resulting soil compaction and increase in surface water runoff resulting in increased erosion of exposed soils.	Localised organic soils and Glacial Till deposits.	Medium	Small Adverse	Slight	-	-

Table 9-16: Residual Impact Significance for Sensitive Hydrogeological Attributes

Activity	Potential Impact	Receptor	Sensitivity	Prior to Mitigation		After Mitigation	
				Magnitude	Significance	Magnitude	Significance
Construction Phase							
Earthworks associated with the construction of the proposed turbines and associated infrastructure	Potential for groundwater pollution from the removal of overburden deposits. Potential for silt discharge in watercourses and infiltration to groundwater as a result of increased surface runoff and reduced protection of the aquifer. Potential for contamination to ground and groundwater from spills/leakages during construction phase earthworks. Reduction in groundwater levels from dewatering of excavation as required during the construction phase.	Locally Important Bedrock Aquifer. Groundwater Wells.	Medium	Moderate Adverse	Moderated	Negligible	Imperceptible
Earthworks associated with the construction of the proposed turbines and associated infrastructure	Slope Failure	Locally Important Bedrock Aquifer. Groundwater Wells.	Medium	Small Adverse	Slight	Negligible	Imperceptible

Activity	Potential Impact	Receptor	Sensitivity	Prior to Mitigation		After Mitigation	
				Magnitude	Significance	Magnitude	Significance
Earthworks associated with the construction of the Proposed Substation	Potential for groundwater pollution from the removal of overburden deposits. Potential for silt discharge in watercourses or infiltration to groundwater as a result of increased surface runoff and reduced protection of the aquifer. Potential for contamination to ground and groundwater from spills/leakages during construction phase earthworks. Reduction in groundwater levels from dewatering of excavation as required during the construction phase.	Locally Important Bedrock Aquifer. Groundwater Wells.	Medium	Small Adverse	Slight	Negligible	Imperceptible

Activity	Potential Impact	Receptor	Sensitivity	Prior to Mitigation		After Mitigation	
				Magnitude	Significance	Magnitude	Significance
Construction of Internal Site Access Tracks, Hardstands and Temporary Compound	Potential for groundwater pollution from the removal of overburden deposits. Potential for silt discharge in watercourses or infiltration to groundwater as a result of increased surface runoff and reduced protection of the aquifer. Potential for contamination to ground and groundwater from spills/leakages during construction phase earthworks. Reduction in groundwater levels from dewatering of excavation as required during the construction phase.	Locally Important Bedrock Aquifer. Groundwater Wells.	Medium	Small Adverse	Slight	Negligible	Imperceptible

Activity	Potential Impact	Receptor	Sensitivity	Prior to Mitigation		After Mitigation	
				Magnitude	Significance	Magnitude	Significance
Construction of the Proposed Substation	Potential for groundwater pollution from the removal of overburden deposits. Potential for silt discharge in watercourses or infiltration to groundwater as a result of increased surface runoff and reduced protection of the aquifer. Potential for contamination to ground and groundwater from spills/leakages during construction phase earthworks. Reduction in groundwater levels from dewatering of excavation as required during the construction phase.	Locally Important Bedrock Aquifer. Groundwater Wells.	Medium	Small Adverse	Slight	Negligible	Imperceptible

Activity	Potential Impact	Receptor	Sensitivity	Prior to Mitigation		After Mitigation	
				Magnitude	Significance	Magnitude	Significance
Construction of Turbine Foundations.	Potential for groundwater pollution from the removal of overburden deposits. Potential for silt discharge in watercourses or infiltration to groundwater as a result of increased surface runoff and reduced protection of the aquifer. Potential for contamination to ground and groundwater from spills/leakages during construction phase earthworks. Reduction in groundwater levels from dewatering of excavation as required during the construction phase.	Locally Important Bedrock Aquifer. Groundwater Wells.	Medium	Small Adverse	Slight	Negligible	Imperceptible

Activity	Potential Impact	Receptor	Sensitivity	Prior to Mitigation		After Mitigation	
				Magnitude	Significance	Magnitude	Significance
Construction of Proposed Substation Foundations	Potential for groundwater pollution from the removal of overburden deposits. Potential for silt discharge in watercourses or infiltration to groundwater as a result of increased surface runoff and reduced protection of the aquifer. Potential for contamination to ground and groundwater from spills/leakages during construction phase earthworks. Reduction in groundwater levels from dewatering of excavation as required during the construction phase.	Locally Important Bedrock Aquifer. Groundwater Wells.	Medium	Small Adverse	Slight	Negligible	Imperceptible

Activity	Potential Impact	Receptor	Sensitivity	Prior to Mitigation		After Mitigation	
				Magnitude	Significance	Magnitude	Significance
Construction of Internal Cabling	Potential for groundwater pollution from the removal of overburden deposits. Potential for silt discharge in watercourses or infiltration to groundwater as a result of increased surface runoff and reduced protection of the aquifer. Potential for contamination to ground and groundwater from spills/leakages during construction phase earthworks. Reduction in groundwater levels from dewatering of excavation as required during the construction phase.	Locally Important Bedrock Aquifers. Groundwater Wells.	Medium	Small Adverse	Slight	Negligible	Imperceptible
Construction of cabling for the Proposed Substation	Potential for groundwater pollution from the removal of overburden deposits. Potential for silt discharge in watercourses or infiltration to groundwater as a result of increased surface runoff and reduced protection of the aquifer. Potential for contamination to ground and groundwater from spills/leakages during construction phase earthworks.	Locally Important Bedrock Aquifers. Groundwater Wells.	Medium	Small Adverse	Slight	Negligible	Imperceptible

Activity	Potential Impact	Receptor	Sensitivity	Prior to Mitigation		After Mitigation	
				Magnitude	Significance	Magnitude	Significance
Operational Phase							
Operational traffic, refuelling of vehicles	Some operational traffic will be necessary for maintenance plus normal operational traffic which could result in minor accidental leaks or spills of fuel/oil.	Locally Important Bedrock Aquifer. Groundwater Wells.	Medium	Negligible	Imperceptible	Negligible	Imperceptible
Decommissioning Phase							
Removal of Turbines and Hardstands	Potential for groundwater pollution from the removal of overburden deposits. Potential for silt discharge in watercourses or infiltration to groundwater as a result of increased surface runoff and reduced protection of the aquifer. Potential for contamination to ground and groundwater from spills/leakages during construction phase earthworks.	Locally Important Bedrock Aquifer. Groundwater Wells.	Medium	Small Adverse	Slight	Negligible	Imperceptible

Activity	Potential Impact	Receptor	Sensitivity	Prior to Mitigation		After Mitigation	
				Magnitude	Significance	Magnitude	Significance
Cumulative Impacts							
Large-scale developments within 20km of the Site occurring concurrently with construction of the Proposed Development.	Potential for groundwater pollution from runoff from Proposed Wind Farm.	Locally Important Bedrock Aquifer. Groundwater Wells.	Medium	Negligible	Imperceptible	-	-
Vegetation Clearance	Potential for silt discharge in watercourses or infiltration to groundwater as a result of increased surface runoff and reduced protection of the aquifer. Potential for contamination to ground and groundwater from spills/leakages during construction phase earthworks.	Locally Important Bedrock Aquifer. Groundwater Wells.	Medium	Small Adverse	Slight	-	-
Enabling TDR Works	Removal of overburden material and exposure of underlying subsoil to erosion. Construction traffic resulting soil compaction and increase in surface water runoff resulting in increased erosion of exposed soils.	Locally Important Bedrock Aquifer. Groundwater Wells.	Medium	Small Adverse	Slight	-	-

9.7.2. Cumulative Residual Impacts of the on-site infrastructure of the Proposed Development

There are no cumulative residual impacts over and above those considered for the turbines and on-site infrastructure as detailed above.

9.7.3. Residual In-Combination Impacts of the entire Proposed Development with other permitted or proposed developments

There are no further residual in-combination impacts over and above those considered for the turbines and on-site infrastructure above when considering other permitted and proposed developments.

9.8. Conclusions

The assessment of Soil, Geology and Hydrogeology has established a baseline for the receiving environment for the impact assessment. Potential impacts were considered for the construction, operational and decommissioning phases of the Proposed Development as well as potential residual and cumulative impacts. Mitigation measures have been proposed where relevant.

The Proposed Development site is not a sensitive site in terms of soil, geology and hydrogeology, and poses a low risk of landslide.

The subsoils across the site comprise predominantly till derived from limestone and cutover peat. This was confirmed during the site assessment works. No bedrock was encountered during the site works and deep rockhead level is expected (>20mBGL), according to local boreholes recorded by GSI.

No slope stability issues were identified on the site. Slopes are shallow (<3°) with peat depths of up to 5.4m recorded during the site walkovers within the Proposed Development site. A peat stability assessment report (P22242-FT-ZZ-01-RP-GE-0001) has been undertaken which concludes that the risk of a peat slippage at the site is very low.

Findings from the site walkover surveys indicates no visual evidence of historic or contemporary landslides or ground instability at or adjacent to the proposed infrastructure locations.

The site is not expected to result in any significant, negative cumulative effects with other existing or permitted developments in the vicinity.

A number of potential impacts have been identified associated with the excavation of soil on the site. The significance of these potential impacts is assessed as being slight to moderate significance prior to mitigation.

With mitigation measures, outlined in Section 9.6, put in place during construction, operational and decommissioning stage the Proposed Development will have imperceptible significance on the soils, geology and hydrogeology

.

9.9. References

IGI. (2013). Geology in Environmental Impact Statements. Institute of Geologists of Ireland.

Sleeman, A.G. & Pracht, M. (1994) 'Geology of Kildare-Wicklow Sheet 16 Book & Map. Description of the Bedrock Geology 1:500,000 Scale Map Series, Sheet 16, Kildare-Wicklow'

Kildare County Development Plan 2023-2029. Available at:

https://kildarecoco.ie/AllServices/Planning/DevelopmentPlans/KildareCountyDevelopmentPlan2023-2029/

County Kildare Groundwater Protection Scheme, 2002:
https://gsi.geodata.gov.ie/downloads/Groundwater/Reports/GWPS/KE_GWPS_MainReport_Dec2002.pdf

Aerial imagery from Google and Bing accessed in 2024

OSI. Online Historic Maps. Ordnance Survey of Ireland OSI. http://map.geohive.ie/

Department of Environment, Heritage and Local Government. Wind Farm Planning Guidelines. s.l. : DoEHLG, 2006.

Irish Wind Energy Association. Best Practice Guidelines for the Irish Wind Energy Industry. s.l. : IWEA Wind Skillnet, 2012.

Flood Info. Flood Risk Data – Interactive Map Viewer. https://www.floodinfo.ie/map/floodmaps/#

NPWS. NPWS Map Viewer. https://www.npws.ie/maps-and-data

GSI. Online Data Viewer. Geological Survey of Ireland.
https://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228

EPA. Online Database Viewer. Environmental Protection Agency Ireland.
https://gis.epa.ie/EPAMaps/

EU. European Union. Digital Elevation Model over Europe.
https://data.europa.eu/euodp/en/data/dataset/data_eu-dem

Scotland, Natural. Peat Landslide Hazard and Risk Assessments. Best Practice Guidelines for Proposed Electricity Generation Developments. s.l. : The Scottish Executive, Dec 2006.

Taluntais, F. (1980). The General Soil Map of Ireland, second edition. National Soil Survey of Ireland:
https://www.teagasc.ie/environment/soil/soil-maps/

FEHILY TIMONEY

DESIGNING AND DELIVERING
A SUSTAINABLE FUTURE

www.fehilytimoney.ie