Chapter 8: Land, Soils and Geology

Coolglass Wind Farm Vol. 2 EIAR

Coolglass Wind Farm Limited

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Acronyms and Abbreviations

SLR	SLR Consulting Limited
EIAR	Environmental Impact Assessment Report
EIA	Environmental Impact Assessment
EU	European Union
IGI	The Institute of Geologists of Ireland
EPA	Environmental Protection Agency
ISIS	Irish Soil Information System
GSI	Geological Survey of Ireland
IFS	Irish Forestry Soils
IGH	Irish Geological Heritage
NHA	Natural Heritage Area
OSI	Ordnance Survey Ireland
ERT	Electrical Resistivity Tomography
TDR	Turbine Delivery Route
Site	The subject Site where the Proposed Development is located
Proposed Development	As defined in Section 3.1.1 of Chapter 3 of this EIAR

8.0 Land, Soils and Geology

8.1 Introduction

This section of the EIAR provides a description of the existing land, soils and geological setting at the regional and local scale, an assessment of the impact of the Proposed Development on the land, soils and geological features of the area and also other geological aspects of the Proposed Development during the construction, operation and decommissioning phases.

All elements of the Project are described in Section 3.5 (Chapter 3.0) of this EIAR and the description of the Proposed Development is found in Section 3.8.1 (Chapter 3.0) of this EIAR.

8.1.1 Statement of Authority

This chapter of the EIAR was prepared by Paul Gordon (EurGeol, PGeol) and Hannah McGillycuddy (MIT) of SLR Consulting.

- Paul has a BSc in Geology and an MSc in Environmental Management and has over 20 years' professional experience, primarily in the Irish minerals industry in writing land, soils and geology chapters for EIARs in Ireland.
- Hannah has a BSc in Geology and an MSc in Exploration Field Geology and has 6 years' professional experience in writing land, soils and geology chapters for EIARs in Ireland.

A geophysical site investigation has been carried out by Apex Geophysics Ltd. at the site of proposed turbine T8. The survey was carried out at this location as this is the most proximal (150m west) to mapped historical coal workings. The geophysical report detailing the investigation, is provided in Appendix 8.1 and has been considered by the chapter authors within the impact assessment. Apex Geophysics Ltd. was founded in 2019 and is a specialist consultancy in the application of geophysics.

8.2 Scope of Work/EIA Scoping

This EIAR is based on a desk study of the Site / surrounding lands using published geological data, information from online data sources (refer to Section 8.4.4 below), a geophysical survey and walkover site visits previously carried out by SLR (8th, 9th and 10th November 2021).

8.3 Regulatory Background

8.3.1 EU Directives

The following EU Directive relate to Land, Soils and Geology at the Site in this EIAR:

- Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment ('the EIA Directive')

- Directive 2006/21/EC of the European Parliament and of the Council of 15 March 2006 on the management of waste from extractive industries ("Management of Waste Directive"); andDirective 2004/35/CE of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage ("Environmental Liability Directive").

The EIA Directive sets out the information required in an EIAR. The Management of Waste Directive and the Environmental Liability Directive regulate the activities at the Site.

8.3.2 Irish Legislation

The following legislation relates to Land, Soils and Geology at the Site in this EIAR:

- S.I. No. 296 of 2018, European Communities (Planning and Development) (Environmental Impact Assessment) Regulations 2018;
- S.I. No. 473 of 2011, European Union (Environmental Impact Assessment and Habitats) Regulations 2011;
- S.I. No. 584 of 2011, European Union (Environmental Impact Assessment and Habitats) (No.2) Regulations 2011;
- S.I. No. 272/2009 – European Communities Environmental Objectives (Surface Waters) Regulations 2009, and subsequent amendments; and
- S.I. No. 9/2010 – European Communities Environmental Objectives (Groundwater) Regulations) 2010, and subsequent amendments.
- The Planning and Development Act 2000 as amended.

8.3.3 Guidelines

The Land, Soils and Geology Chapter of this EIAR has been prepared in accordance with the following guidelines:

- Department of Housing, Planning and Local Government (2018). Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment;
- Environmental Protection Agency (2022). Guidelines on the Information to be Contained in Environmental Impact Assessment Reports. Environmental Protection Agency, Johnstown Castle Estate, Co. Wexford;
- Geological Survey of Ireland, Irish Concrete Federation (2008) Geological Heritage Guidelines for the Extractive Industry;
- Institute of Geologists of Ireland (2013). Guidelines for the preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements;
- Irish Wind Energy Association (2012). Best Practice Guidelines for the Irish Wind Energy;

- Ministry of Agriculture, Fisheries and Food (UK) (2000). Good Practice Guide for Handling Soils. Sheets 1 & 2.
- National Roads Authority (March, 2013). A Guide to Landscape Treatments for National Road Schemes in Ireland;
- National Roads Authority (2008). Environmental Impact Assessment of National Road Schemes - A Practical Guide;
- National Roads Authority (2008). Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes; and
- Transport Infrastructure Ireland (March, 2013). Specification for Road Works Series 600 –Earthworks.

8.4 Baseline Study Methodology

This assessment involved a review of published literature and information, the findings from a walkover survey of the SiteSite and the surrounding geological context and a geophysical survey which was carried out on one of the proposed turbine locations.

This baseline study describes the receiving environment at and in the immediate vicinity of the Site using the available baseline information gathered, specifically:

- **Context of the receiving environment** - location/ magnitude/ spatial extent and trends of the environmental factors;
- **Character of the receiving environment** - distinguishing aspects of the environment being considered here;
- **Significance of the receiving environment** - the quality, value or designation is assigned to the existing environment; and
- **Sensitivity of the receiving environment** - how sensitive is the aspect of the environment to change.

The baseline study is a qualitative assessment of the available information based on professional experience and interpretation of the available data.

8.4.1 Geographical and Temporal Study Area

For the purposes of this assessment, the geographical study area includes the turbines (and associated infrastructure), both cable route options, the meteorological mast and the amenity trail and a 2 km offset from these when considering land, soils and geology aspects. This is in line with the recommended study area in the IGI's "Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapter of Environmental Impact Statements" (2013). The TDR will follow an existing road network with no likely direct interaction with land, soils or geology and in the context of the assessment in this chapter, the study area for the TDR follows the TDR route only.

The temporal scope of the assessment covers the construction, operation and decommissioning phases for the Proposed Development.

8.4.2 Sources of Information

The following sources of information were consulted in the preparation of the receiving environment baseline study for Land, Soils and Geology:

- Environmental Protection Agency (https://gis.epa.ie/EPAMaps/);
- Geological Survey of Ireland (www.gsi.ie);
- Geological Survey of Ireland, 2007. "Kilkenny – County Geological Site Reports";
- Geological Survey of Ireland, 2016. "Laois – County Geological Site Reports";
- Google Earth Historical Imagery (various dates between November 2005 – October 2022 using Google Earth Pro https://www.google.com/earth/versions/);
- Irish Geological Heritage Programme (https://www.gsi.ie/en-ie/programmes-and-projects/geoheritage/Pages/Data-and-Maps.aspx);
- Irish Soils Information System (https://www.teagasc.ie/environment/soil/irish-soil-information-system/);
- Memoirs of the Geological Survey, 1881. "Geology of the Leinster Coalfields"; and
- Ordnance Survey Ireland, Cassini 6" map (1830s - 1930s), 6" historical map (1837 – 1842), 25" historical map (1888 - 1913) and aerial imagery (1995 – 2018) (https://webapps.geohive.ie/mapviewer/index.html)

8.5 Baseline Environment

8.5.1 Land

Within the EIA Directive land is recognised as a 'natural resource'. The EIA Directive also refers to the importance of the sustainable use of soil and the need to address the unsustainable increase in settlement areas over time ('land take'). Therefore, the issues of land as both a natural resource and land take must be considered in an EIAR.

The Preamble section to the EIA Directive (as amended by 2014/52/EU) notes that the:

> *"Final document of the United Nations Conference on Sustainable Development held in Rio de Janeiro on 20-22 June 2012, which recognises the economic and social significance of good land management, including soil, and the need for urgent action to reverse land degradation. Public and private projects should therefore consider and limit their impact on land, particularly as regards land take, and on soil, including as regards organic matter, erosion, compaction and sealing; appropriate land use plans and policies at national, regional and local level are also relevant in this regard".*

Land can be considered to be a resource with a beneficial use to society, for example agricultural land use, extractive industry land use or urban residential land use. Excess or unnecessary land take may therefore result in the loss or sterilisation of key land resources.

This in turn has the potential to have adverse social and economic consequences for society.

A review of the 6" historical maps and the 25" historical map shows the study area contained a mixture of scattered fields, sparse residential housing and farmsteads during the period 1839s-1942 and 1888 – 1913 (OSI, 2023). No extensive woodland is present within the study area during this period (1830s – 1910s). Disused coal shafts are noted on the maps in the Wolfhill, Kylenabehy and Cressard townlands, within the south of the study area. These will be given further consideration in the baseline assessment in Sections 8.5.6 and 8.5.7, below. townlands, within the south of the study area. These will be given further consideration in the baseline assessment in Sections 8.5.6 and 8.5.7, below.

A review of Google Earth imagery (November 2005 - August 2022) and OSI aerial imagery (1995 – 2018) identifies that dense conifer forestry has occupied much of the Site and wider study area during this time. From August 2016 onwards, several sections of the conifer forestry within the central study area were removed. Felling and replanting of felled sections is part of the standard lifecycle of a conifer forest which serves the timber industry.

Other land uses in the study area consist of small agricultural fields, walking trails associated with Fossy Mountain, farmsteads, the small village of The Swan and scattered residential housing along the minor road network in the area.

Corine Landcover 2018 classifies the study area as predominately Coniferous and Mixed Forest and Transitional Areas interspersed with Agricultural Areas.

The TDR is in current use as part of the existing regional, national and road network between the Site and Dublin Port.

8.5.2 Soils Baseline

Soil is defined as the top layer of the earth's crust and is formed by mineral particles, organic matter, water, air and living organisms. Soil is an extremely complex, variable and living medium and its characteristics are a function of parent subsoil or bedrock materials, climate, relief and the actions of living organisms over time.

Soil formation is an extremely slow process and can take thousands of years to evolve; soil can be considered essentially as a non-renewable resource.

As the interface between the earth, the air and the water, soil performs many vital functions; it supports food and other biomass production (forestry, biofuels etc.) by providing anchorage for vegetation and storing water and nutrients long enough for plants to absorb them. Soil also stores, filters and transforms other substances, including carbon and nitrogen, and has a role supporting habitats serving as a platform for human activity.

8.5.2.1 National Soils

The ISIS project was undertaken by the EPA and Teagasc, and has gathered together existing information and data from soil survey work in Ireland, which has been augmented with new field data, leading to the production of a new national soil map at a scale of 1:250,000 (www.teagasc.ie/soils).

The ISIS project has identified a number of Soil Associations across Ireland, which are each comprised of a range of soil types (or 'Series'), each of them different in properties, with different environmental and agronomic responses. For each soil type, the properties have been recorded in a database maintained by Teagasc.

The soil association classified beneath the majority of the Site is the Crosstown Association (1030a), which is a fine loamy drift with siliceous stones (see **Figure 8-1**). Part of the Site around turbine location T1 is underlain by the Ballylanders Association (1100e). Turbine location T1 itself is underlain by the Crosstown Association.

The Crosstown Association consists of luvisols 'with Surface-water Gleys, Stagnic Brown Earths and in lower lying or flat areas with some Groundwater Gleys'. The Stagnic Luvisol are luvisols which display stagnic properties, due to water stagnation occurring below 40 cm for parts of the year, as a result of a higher clay content at dept (Creamer et. al. 2018). These soils are considered to be 'heavy' for agricultural purposes.

The National Soil Map of Ireland highlights that the wider study area (within the 2km study area buffer) is underlain by the following soil types:

- Ballylanders (1100e) - Fine loamy soil (brown earth) over shale and slate bedrock;
- Elton (1000c and 1000a) - fine, loamy drift with limestones. The soils in this association are considered to have good agricultural potential being friable deep soils with plentiful, well-developed roots and a high base saturation with good nutrient retention. Found within the north of the study area;
- River alluvium (05RIV) - similar features to gleys, with generally poor drainage. Confined to river and drainage areas within the study area;
- Baggotstown (1150a) – coarse loamy soil over calcareous gravels;
- Howardstown (0760c) – a clayey soil formed in a clayey glacial drift with limestones. Found within the east of the study area; and
- Kilrush (0700b) - Fine loamy drift with siliceous stones. A typical surface water gley found to the west and east of the study area.

The soils in the immediate vicinity of the Proposed Development Site are used for plantation forestry.

Soils immediately beneath the TDR area underlie the road network and comprise engineered fill/Made Ground.

8.5.2.2 Subsoils

The Quaternary (Subsoil) deposits were deposited during the last 2 million years, and essentially comprise the unconsolidated materials overlying bedrock. The two predominant types of quaternary subsoils in Ireland are glacial till, deposited at the base of ice sheets, and sand and gravel deposits, associated with the melting of the ice sheets and are generally termed 'glaciofluvial outwash sands and gravels.' Other extensive Quaternary subsoils in Ireland include peat, river alluvium and coastal process deposits. Most

Quaternary subsoils in Ireland were deposited after the maximum of the last glaciation, the Midlandian, which occurred approximately 17,000 years ago.

The subsoils across Ireland have been mapped on a national basis by Teagasc as part of the EPA Soil and Subsoil Mapping Project for the IFS project. The subsoil mapping was undertaken at a national basis using existing Quaternary Geology maps, publications, remote sensing and field mapping and sampling.

The subsoils previously covering and adjacent to the Site have been mapped under the IFS project. The Proposed Development is predominantly underlain by Namurian shale and sandstone till (TNSSs) or bedrock is at or near surface (Rck), see **Figure 8-2**. Part of the redline application boundary surrounding turbine location T11 is underlain by undifferentiated gravelly alluvium, T11 itself is located on Namurian shale and sandstone till.

The wider study area (within the 2km study area buffer) contains the following subsoils:

- an undifferentiated alluvium to the west and north of the study area, associated with drainage networks;
- esker sands and gravels of basic parent material (BasEsk) in the northern study area;
- limestone till from the carboniferous (TLs) in the northern study area;
- made ground to the south where there is a quarry site and the small village of The Swan, and a section to the north around Timahoe village; and
- Carboniferous limestone sands and gravels (GLs) to the north and west.

Subsoils immediately beneath the TDR area underlie the road network and comprise engineered fill/Made Ground.

8.5.3 Bedrock Geology

The study area is located on the northern limb of an upraised outlier which forms the Castlecomer Plateau. The outlier is often referred to as the Leinster Coalfield, due to the coal seams which were mined until the late 20th century. The sequence is of Namurian age, the lowest part of the Upper Carboniferous.

Bedrock mapping published by the GSI (GSI, 2023) 1:100,000 mapping, reproduced in **Figure 8-3**, indicates that the sequence is comprised predominantly of various sandstone, siltstone and shale formations. A generalised stratigraphy of the area is presented in **Table 8-1**. Younging is identified by the GSI (GSI, 2023) as to the south with shallow dips (5 -15 ˚) to the south-southwest.

Table 8-1 Lithological Sequence Present within the Study Area

Unit Name	Description
Coolbaun Coal Formation	Shale and sandstone with thin coals
Clay Gall Sandstone Formation	Feldspathic quartzitic sandstone
Moyadd Coal Formation	Shale, siltstone and minor sandstone, with thin coals
Bregaun Flagstone Formation	Thick, flaggy sandstone and siltstone
Killeshin Siltsone Formation	Muddy siltstone and silty mudstone
Luggacurren Shale Formation	Mudstone and shale with chert and limestone
Clongrenan Formation	Cherty, muddy, calcarenitic limestone
Ballyadams Formation	Crinoidal wackestone/packstone limestone

Mapping by the GSI (GSI, 2023) indicates that three of the proposed turbine locations are underlain by the Killeshin Siltstone; four by the Bregaun Sandstone; one by the Moyadd Coal; two by the Clay Gall Sandstone; and three by the Coolbaun Formation.

Bedrock geology beneath the TDR area comprise various sequences of Carboniferous limestones and a calcareous greywacke of the Carrighill Formation.

8.5.4 Geological Heritage

Seven audited geological heritage sites, reproduced in **Figure 8-4** and are found within the study area, however, no geological heritage sites occur within the immediate Site area (GSI, 2023). No unaudited heritage sites are found within the study area.

The ten geological heritages sites are:

- Flemings Fireclay Quarries (LS012), 1km south of the Site;
- Clogh River (KK014), 400m south of the Site;
- Clogh River (LS007), 400m south of the Site;
- Luggacurren Fireclay Pit (LS020), 1.3km east of the Site;
- Luggacurren Stream Section (LS021), 1.4km east of the Site;
- Moyadd Stream (LS025), 1km west of the Site;
- Castlecomer Borehole – Swan (LS006), 900m southeast of the Site;
- Modubeagh (LS024), 1km west of the Site;
- Timahoe Esker (LS033), 80m south of the cable route; and
- Kyle Spring (LS018), 2.5km east of the cable route.

Geological heritage sites are categorised into 16 IGH themes. The 16 IGH themes include themes that are predominantly centred on the geological age of the feature, but several themes relate to the style of the deposit (e.g. mineralogically of interest). Up to four IGH themes can be attributed to each geological heritage site.

Flemings Fireclay Quarries is listed under the theme IGH9 (Upper Carboniferous and Permian). The Laois County Geological Site Report (GSI, 2016) identifies Flemings Fireclay Quarries as *"extensive quarries worked for fireclay since 1935"*. The Double Fireclay Member that is quarried lies within the Coolbaun Coal Formation, although no coal seam is associated with the member. The Double Fireclay Member is noted as extensive in the area and is an important marker bed in boreholes and historical coal mines. The geological site importance of Flemings Fireclay Quarries is that it is *"a good representative of part of the Westphalian succession of the Leinster coalfield, and as such may be considered as a candidate for Natural Heritage Area (NHA) status"*.

Clogh River is listed under two geological heritage site codes: KK014 and LS007. However, the site boundary of the geological heritage site identifies the same feature and extent under both site codes; the double counting of the Site arises as it lies within both County Kilkenny and County Laois and is assigned a site code for each County Council. Two separate county geological site reports were reviewed for this baseline assessment (GSI, 2016 and GSI, 2007).

Clogh River is listed under theme IGH 14 (Fluvial and Lacustrine Geomorphology). It is described in the (Kilkenny) county geological report as a section of the Clogh River which covers a distance of 2.5 km (GSI, 2007). In the (Laois) county geological report it is described as a meandering river with braided channels (GSI, 2016). The geological site importance of Clogh River is the fluvial geomorphology and educational opportunity to observe its responses and changes due to flash flooding and prolonged flooding events.

Luggacurren Fireclay Pit is listed under theme IGH9 (Upper Carboniferous and Permian). It is described as a "*farm borrow-pit*" which exposes Namurian rocks of the Killeshin Siltstone Formation. It is described in the county geological report as a complement to the Luggacurren Stream section. The geological site importance of Luggacurren Fireclay Pit is that it is a good representative geological section, although it is occasionally in use to supply shale and fireclay.

Luggacurren Stream Section is listed under themes IGH3 (Carboniferous to Pliocene Palaeontology) and IGH9 (Carboniferous and Permian). It is also known as "The Crooked River" and has exposures of Namurian rocks of the Luggacurren Shale Formation and the lower part of the Killeshin Silstone Formation. The geological site importation of Luggacurren Stream Section is that it is a well-studied, reasonably well exposed and good representative exposure of Namurian Leinster Coalfield rocks. It is likely to be proposed for NHA status.

Moyadd Stream is listed under theme IGH9 (Upper Carboniferous and Permian). It is described as a small river that has 1km of exposed bedrock along the riverbed and banks. This is the type section for the Moyadd Coal Formation. The geological site importance of the Moyadd Stream is that there is a general lack of exposure for the Leinster Coalfield and this extensive exposure site is of note.

Castlecomer Borehole – Swan is listed under theme IGH16 (Hydrogeology). It is described in the country geology report as an artesian borehole drilled into Upper Carboniferous bedrock (GSI, 2016). It consists of a pump house (elevation 170mOD) with a borehole drilled to 39m which taps into the Swan Sandstone confined aquifer. Static water level associated with the borehole is 174mOD. The geological site importance of Castlecomer

Borehole – Swan is that it represents an important hydrogeological phenomenon (artesian well and confined aquifer behaviour). It is also an example of a public water supply (GSI Well ID 2317NE W07) which serves the community through the Swan Water Supply Scheme.

Modubeagh is listed under theme IGH16 (Hydrogeology) and IGH15 (Economic Geology). It is described as an abandoned coal mine which is largely overgrown (GSI, 2016). It contains several extant surface features such as the remains of mine buildings and a collapsed shaft. The geological site importance is that this represents a rare example of surface traces of pre-20th century mining in the Leinster Coalfield.

Timahoe Esker is listed under theme IGI7 (Quaternary). It is described as a number of high, sinuous ridge segments, which all form part of the same esker system. The geological site importance is that it represents a good example of a deglacial meltwater complex, some deposited under ice, some at the margin.

Kyle Spring is listed under theme IGH16 (Hydrogeology). It is a natural freshwater spring that is the source of a public water supply. Its geological importance is that it is a high yielding spring issuing from a regionally important karstified limestone aquifer.

Along the TDR area, one geological heritage site is mapped by the GSI as including the existing M7 motorway. This is The Curragh which is listed under IGH7 (Quaternary). It is described as a unique deposit of fluvio-glacial gravels which can reach thicknesses of 70m.

Further consideration is given in Sections 8.5.6 and 8.5.7, below, to other evidence of historical coal mining in the study area which is undesignated.

8.5.5 Economic Geology

A review of the GSI's mineral localities (GSI, 2023) shows that eight mineral localities occur within the study area. Three mineral localities relate to coal, two relate to fireclay and one relates to clay and brick. Two other mineral localities are found within the north of the study area, these both relate to sand and gravel deposits.

Figure 8-5 shows historical coal workings in the vicinity of the Site (GSI,2023).

The first coal locality is in the townland of Kylenabehy, 150 m to the west of the Site. The note associated with this states *"several coal pits noted in this townland"*. A review of OSI historical mapping (6" and 25" maps) does not identify coal mining locations in this townland.

The second coal locality is in the townland of Crissard, 150m to the east of the Site. The note associated with this states *"coal pits noted in this townland on old 6 in. map"*. Both the 6" and 25" historical maps identify a linear area (ca. 700 m long) of disused coal shafts that were present, at least up to 1913 (OSI, 2023). In relation to the Proposed Development, proposed turbine location T8 is proximal (150m) to the western limit of these historical mapped shaft locations. The findings of a geophysical investigation to further investigate the potential for coal shafts in this area is considered further in Section 8.5.6, below.

The third coal locality is in the townland of Wolfhill, 500m to the east of the Site. The note associated with this states "*several coal pits noted in this townland on old 6 in. map"*. Both the 6" and 25" historical maps identify numerous coal shafts within this townland, both

disused and in use at the time (OSI, 2023). None of these shafts are proximal to the Site. Further evidence of coal mining into the 20th century has been recorded in an article in The Laois Peopla (27th July 2018). The article states that the Wolfhill Mine operated here between 1939 and 1961 and employed 166 people at its peak.

No coal mining is currently undertaken in the study area, and these identified localities relate to historical coal pits. Lands over these historical coal pit locations are now conifer planation in the case of the Crissard and Kylenabehy localities and the Wolfhill locality is now an agricultural field.

The first fireclay locality is located in the townland of Slatt Lower, 1km to the south of the Site and relates to a former fireclay quarry (Flemings Fireclay Quarries) which is discussed previously in Section 8.5.5, above.

The second fireclay locality is located in the townland of Slatt Lower,. 1.6km to the southwest of the Site and the note associated with this identifies that it occurs as a seam of fireclay in a shaft.

The clay and brick is located in the townland of Luggacurren, 600m east of the Site. This occurrence relates to clay which was excavated for brick and tile manufacture. No current evidence of this is visible on aerial imagery and the area is now occupied by an agricultural field.

The two sand and gravel mineral localities are located in the townlands of Kyle and Coolnabecky, 1 km south of the cable route and 3 km north of the Site.

In addition, there are 3 historical quarries noted on the OSI's 25 inch and 6 inch maps which date to the early – mid 20th Century. All three are found to the south of the study area and outside of the Site. The commodity quarried here historically is not identified on these maps. Aerial imagery (October 2022, Google Earth) of the Site shows the land use is now either agricultural fields or light industrial with no obvious sign of quarrying.

8.5.6 Site Investigations and Field Assessments

A geophysical investigation was carried out by Apex Geophysics between 24th and 25th May 2022 to investigate the presence of a potential coal shaft near to proposed turbine T8. The survey involved the collection of 2D Electrical Resistivity Tomography (ERT) profiles. A copy of the geophysical investigation report is provided in Technical Appendix 8.1 found in Volume III of this EIAR.

ERT images the electrical resistivity of the materials in the subsurface along a profile to produce a cross-section showing the variation in resistivity with depth. Each cross-section will be interpreted to determine the material type along the profile based on typical resistivities returned for Irish ground materials.

Four ERT profiles were collected in the area of the proposed turbine T8. The findings of the survey indicate that soil in the area consists primarily of sandy gravelly clay with small pockets of silt/clay and clayey silty sand/gravel at or close to the surface. Soil thickness ranges from 0.9mbgl 18m south of T8 to 6.8 – 8.8m 27m north and 21 east of T8. Underlying this material, the survey indicates possible mudstone/siltstone and sandstone rock.

The survey did identify three anomalous zones beneath the possible rockhead. These three anomalous zones are as follows:

- A vertical/subvertical zone of reduced model resistivity values (<300 Ohm-m) indicating the presence of a possible shaft (Zone A) close to the proposed turbine base (See Drawings AGP22027_02 to AGP22027_04, Technical Appendix 8.1 found in Volume III of this EIAR).
- A horizontal/subhorizontal zone of reduced model resistivity values (<350 Ohm-m) indicating the presence of a possible adit (Zone B) 5 to 20 m west of the proposed turbine base (See Drawing AGP22027_02, Technical Appendix 8.1 found in Volume III of this EIAR).
- A vertical/subvertical zone of slightly reduced model resistivity values (<400 Ohm-m) indicating the presence of a possible shaft (Zone C) approximately 15 m south of the turbine base (see ERT profile R3 on Drawing AGP22027_03, Technical Appendix 8.1 found in Volume III of this EIAR).

The survey data indicates that the features are not open, modelled resistivity values of <350 Ohm-m indicate that these features contain sandy/gravelly clay and clayey sand/gravel.

8.5.7 Geohazards

8.5.7.1 Landslides/Slope Stability

Landslides/mass movements/slope stability issues typically occur due to erosion of features such as cliffs, or due to factors such as slope, saturation/drainage, vegetation, soil structure and loading/disturbance on sites with unconsolidated deposits such as peat. The study area is predominantly within an area of low landslide susceptibility (GSI, 2023).

Some areas such as Fossy Mountain are noted as moderately low to moderately high landslide susceptibility and these are associated within steep elevation increases around the mountain. The Proposed Development is located on gently to moderately sloping ground. There are no recorded landslide events within the study area (GSI, 2023).

8.5.7.2 Radon

Radon is a naturally occurring radioactive gas which forms from the radioactive decay of uranium in predominantly igneous rocks and associated soils. Radon gas can cause lung cancer when a person is exposed to high levels of the gas over a prolonged period of time. The acceptable level (reference level) for workplace radon in Ireland is 300 Bq/m^3. However, outdoor work settings offer little threat from radon exposure as the gas can only become confined and concentrated indoors within a building.

Within the study area, EPA mapping of radon levels is indicated to vary from 1 in 5 homes are likely to have high radon levels to 1 in 20 homes likely to have high radon levels. The higher risk areas are associated with areas where bedrock is at or near surface in the study area, including beneath parts of the Site.

8.5.7.3 Historical Coal Mining

As presented in Sections 8.5.4 and 8.5.5, there is evidence of historical underground mine workings in the study area. However, research indicates that only turbine location T8 is likely to be near mine workings. Geophysical surveying indicates the possible presence of shafts and an adit near to turbine location T8.

8.5.7.4 Karst

Carbonate rocks occur within the Luggacurren Shale Formation and Clogrenan Formation, to the north of the study area. A review of the GSI's karst database identifies an "*Orchard Spring*" within the Clogrenan Formation, 1.9km north of the Site. No other karst features are present within the study area.

8.6 Proposed Development

All elements of the Project are described in Section 3.5 (Chapter 3.0) of this EIAR and the description of the Proposed Development is found in Section 3.8.1 (Chapter 3.0) of this EIAR.

8.7 Impact Assessment

8.7.1 Evaluation Methodology

This evaluation of impacts in this chapter is based on a methodology adheres to the "*Guidelines for the Assessment of Geology, Hydrology and Hydrogeology for National Road Schemes*" *published by the National Roads Authority* (2009), the "*Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements*" published by the IGI (2013) and *"Guidelines on the Information to be contained in Environmental Impact Assessment Reports"* by the EPA (2022).

Table 8-2 below shows the matrix for significance of effect used in this assessment.

Table 8-2 Significance Matrix

	Magnitude of Impact (Degree of Change)				
Environmental Importance (Sensitivity)		**Negligible**	**Low**	**Medium**	**High**
	High	Slight	Slight or moderate	Moderate or large	Profound
	Medium	Imperceptible or slight	Slight or moderate	Moderate	Large or profound
	Low	Imperceptible	Slight	Slight	Slight or moderate
	Negligible	Imperceptible	Imperceptible or slight	Imperceptible or slight	Slight

8.7.2 Selection of Sensitive Receptors

8.7.2.1 Land

Land use in the Site area will change due to the Proposed Development. Removal of conifer forestry will be required at eleven turbine locations, in addition to some linear loss due to the creation of additional internal access tracks. It is proposed to fell 54.36 hectares of coniferous forest for the Proposed Development dependent on turbine type. Replant lands are required.

Lands in current use for conifer forestry will be lost due to the Proposed Development within the Site. This will be considered further in the assessment; consideration within this chapter (Land, Soils and Geology) is given only to the subject of land take/land use loss.

8.7.2.2 Soils and Subsoils

There will be a disturbance to soils and subsoils within the Site, including removal of soils for the turbine bases, excavation of the borrow pit for use of material as fill for access tracks within the Site and the excavation of soils for the cable laying. The quaternary deposits at the Site are ubiquitous in a regional context. However, consideration will be given further in the assessment on the potential impacts to quaternary sediments due to the Proposed Development.

8.7.2.3 Bedrock Geology

The bedrock within the Site is part of the Leinster Coalfield, however, there is no large disturbance as part of the Proposed Development. Consideration will be given further in this assessment to the potential impact to bedrock (e.g. leaks and spills seeping into the bedrock).

8.7.2.4 Geological Heritage

There are nine geological heritage sites within the study area, however, none of these occur at the Site. The most proximally located occurs 400 m south of the Site. The most proximally located geological heritage site to the proposed cable routes (within the study area) is 80 m south. However, due to the nature of the Proposed Development, whereby works on geological features (i.e. soils, subsoils and bedrock) occur within the Site area only and will not extend beyond the Site boundary, the works do not have the potential to encroach on or disturb any of the geological heritage sites within the study area. Geological heritage sites are not considered further in this assessment.

8.7.2.5 Economic Geology

Historically the study area was an important part of the Leinster Coalfield and mining of coal and fireclay/clay was a key economic industry in the early 20th Century. However, coal mining is not currently undertaken, and no active fireclay/clay quarries operate within the area. It is considered unlikely that permission would be sought to recommence coal mining in the locality, partly as seams have previously been worked out. No further consideration will be given to the economic value of the geology (specifically mineral value) beneath the Site.

8.7.2.6 Geohazards

No historical evidence of landslides is recorded within the area and the proposed turbine locations are located on glacial tills or shallow bedrock rather than peat. Slopes are gently to moderately sloping. Slope stability is scoped out in this context and will not be considered further in this assessment.

While some of the Site is located within a higher radon risk area, site works both during construction, operations and potential decommissioning will be outdoors in nature. Radon risk is associated with indoor exposure over a prolonged period, as this will not occur in the context of the Proposed Development, radon risk will not be considered further in this assessment.

Historical coal mining in the context of a potential geohazard is scoped into this assessment due to the potential for underground shafts within the Site, in the area of T8 and the potential impact the Proposed Development may have upon these features, and to other receptors such as workers (human health) and the proposed structures.

Karst is scoped out for further assessment due to the lack of carbonate rocks within the Site area.

Summary

In terms of land, soils and geology baseline considered here, the principal sensitive receptors are shown in **Table 8-3**, below. Importance and reasoning is taken after the National Roads Authority Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (2008) in relation to aspects to be considered and assessment approach.

Table 8-3 Status and Importance Land, Soil and Geology Receptors

Receptor	Importance and Reasoning
Land	Low (conifer forest within Site area, no particular value to locality but will be partially removed from the Site area due to the Proposed Development)
Soils and subsoils	Low (no designation, no rarity, Site importance for sediments to be extracted, moved and reused within the Site as part of the Proposed Development works)
Bedrock Geology	Low (while it is part of the Leinster Coalfield, no direct interaction occurs with the bedrock geology)
Human health/built structure	High (human beings such as workers onsite)

8.8 Potential Effects

The main potential impacts and associated effects that will be considered in this assessment relate to the following:

- Activities or events that might impact quaternary sediment quality during construction and operation phase (e.g. soil contamination by a fuel or oil spill or leakage);
- Geotechnical instability arising due to the presence of historical coal working; and
- Extraction of sediments and their relocation and reuse within the Site as part of development works.

These are considered and assessed in the following sections.

8.8.1 Potential Effects – Construction

Table 8-7 below, summarises the potential effects discussed in the following subsections. All elements of the Project are described in Section 3.5 (Chapter 3.0) of this EIAR and the description of the Proposed Development is found in Section 3.8.1 (Chapter 3.0) of this EIAR.

8.8.1.1 Turbines (and Associated Infrastructure), TDR and Meteorological Mast

The works associated with the Proposed Development will all involve land take whereby existing forestry land is used for the turbine (and associated infrastructure) land use. Approximately 54.36 hectares of coniferous forestry will be felled to enable the Proposed Development. While a large volume of land used for forestry will be lost within this locality, this will be required to be offsite by replanting elsewhere in the State so there is no net loss of forestry overall. The meteorological mast will occupy a land area of 25m x 25m and will result in a very small change in land use at this location from agricultural field to meteorological mast. The potential impact due to land take is considered to be low (adverse) and the significance of effect is considered to be *Slight* for both the turbine locations and meteorological mast.

Land use will not change along the TDR (it is an existing road network) due to its use as the TDR. The TDR will follow existing roads and thereby align with the existing land use. Land take/land use change is not considered further in this assessment for the TDR.

Material (soils, subsoils and in some cases, bedrock) will be required to be excavated at the turbine locations, access tracks and within the borrow pit. In the case of the turbines (and associated infrastructure), this excavation is so that infrastructure components can be installed along with fill material. An estimate of material cut and fill volumes is provided in **Table 8-4.**

Table 8-4 Estimated Cut and Fill Volumes

Parameter	Volume
Volume of material to excavate for turbine foundations	38,070m^3
Total cut for hardstanding areas	316,143m^3
Total fill for hardstanding areas	230,753m^3
Total Cut for Access Tracks	385,748m^3
Total Fill for Access Tracks	230,753m^3

An estimation of the aggregate material quantities for all elements of the Proposed Development has been made; the on-site borrow pit and the excess from the cut and fill requirements are likely to result in all aggregate material being won within the Site. Alternatively, material may also be imported from local quarries in the area if required. **Table 8-5** provides a summary of the material quantities (aggregates only) required on Site.

Table 8-5 Estimated Aggregate Quantities

Proposed Infrastructure	Volume of Aggregate	Approximate Tonnages of Aggregate
Access tracks (new & upgraded)	15,365m^3	23,048t
Turbine bases (area & base formation)	1,217m^3	1,825t
Hardstanding and laydown areas	7,800m^3	11,700t
Substation	15,000m^3	22,500t
Construction compound	6,250m^3	9,375t
TOTAL	**45,632m^3**	**68,448t**

A total of 68,448 tonnes (t) of aggregate material will be required for the construction of the Proposed Development. **Table 8-6** provides material quantities for all other non-aggregate materials.

Table 8-6 Estimated Material Quantities

Construction Activity	Infrastructure	Material Quantities
Turbine Foundations	Installation 6N structural fill	5,131t
	Blinding	738t
	Installation of can/ bolts	13no
	Reinforcement	1,066t
	Plinth shutter	48t
	Base slab perimeter shutter	114t
	Ducts (200mm diameter)	78no
	Ducts (75mm diameter)	78no
	Transformer plinths	13no
	Step plinths	13no
Electrical Connection	Sand layer – (15,507m length by 0.5m x 0.3m)	2,326m^3 (4,187t)
	Cable – drums hold 500m	32no
Concrete	-	1250m^3
Control Building	Reinforcement	48t
Substation Compound	Imported type 1 running surface	1,255t
	Imported 6F2 capping	2,500t

Construction Activity	Infrastructure	Material Quantities
	Class 1C1 Roadbox bulk fill	6,300t
	Class 1 general fill	18,800t

There is no direct loss of in-situ bedrock at the Site, soils will be removed at the Site at turbine locations, access tracks, meteorological mast and within the borrow pit areas. However, the excavated soils will remain onsite and will be reused to build infrastructure items such as access tracks, turbine, hardstanding and substation foundations (i.e. cut-and-fill). The loss of onsite geological resources (soils and subsoils) is considered to be of low impact and the effect significance is considered to be *Slight*.

The TDR will not require the excavation of soil, subsoil or bedrock as it is an existing road network. Further consideration of the TDR is scoped out for consideration of excavation of soils, subsoils and bedrock.

Fuel and oil leaks and spills are a potential indirect impact associated with construction machinery and construction work areas/compounds within the Site. During soil and rock extraction, there is an increased risk to soil and bedrock should a leak or spill occur. However, construction works associated with the turbine locations and site compounds will involve shallow earthworks and infilling of excavations as part of foundation works which will occur within a short time period, reducing the potential exposure risk. The borrow pit area will be partially backfilled with any remaining soils once it is no longer in use. The potential magnitude of impact to soils and subsoils is considered to be low and the potential significance of effect is considered to be *Slight*.

The TDR is an existing road network which does not allow the direct infiltration of spills and leaks to soils, subsoils or bedrock. Further consideration of the TDR is scoped out for soils, subsoils and bedrock due to leaks and spills in this assessment.

The presence of historical coal shafts (and adits) in the area of turbine location T8 is possible after a review geophysical data carried out at the Site. The proposed turbine base for T8 is not located directly over the potential shaft location, however, it is 10 m east of the nearest geophysical anomaly. The geophysical data indicates that if the features are shafts and adits, they appear to be infilled with clays and sands/gravels rather than open void space. Additional site investigation work will be undertaken in advance of construction works which will, in part, aim to identify what the geophysical anomalies are near T8. Works will include borehole drilling to investigate the nature of the anomalies. Should the anomalies be confirmed as historical shafts, consideration will be given to the need to provide additional engineering supports at this location. T8 will not be constructed without an investigation and confirmation of the nature of the geophysical anomalies nearby. The potential magnitude of impact to turbine location T8 due to a historical coal shaft/adit is considered to be negligible and the potential significance of effect is considered to be *Slight*. No potential historical coal shafts (and adits) have been identified in the area of the other turbine locations, it is considered that potential magnitude of impact to other turbine locations is also considered to be negligible and the potential significance of effect is considered to be *Slight*.

8.8.1.2 Cable Route and Recreational Amenity Trail

As part of the construction works, a cable route will be established. This will involve the laying of 9.9km or 10.1km of cables underground, depending on which cable option is progressed. This will be achieved by excavating trenches 600mm wide and 1.2m deep along the cable route, for either option. A bedding layer of sand will be added to the trench and PVC ducts and couplers will be installed on top of this. Trenches will then be backfilled.

In terms of land use change, the nature of the cable route is an underground system, during construction there will be a temporary disturbance to normal land use (i.e. roads). The potential impact magnitude is considered to be negligible and the significance of effect to be *Slight,* for either cable route option.

Disturbance will occur to local soils along the cable route as they are excavated to 1.2m, for either option. Excavated material will be reused during backfilling of the trenches. Excess material will be used to backfill the borrow pit within the Site. No excavated soils will be sent offsite, all soils will be reused within the Site. The potential impact to soils and subsoils through excavation is considered to be low (adverse) and the significance of the effect is considered to be *Slight,* for either cable route option.

During construction, excavation will be carried out by excavators and heavy machinery which have the potential to leak/spill fuels and oils. However, given the confined natured of the works (i.e. small working trench area), small numbers of heavy vehicles will be in use at any one time while excavating or backfilling the trench route. It is considered unlikely in this scenario that a large scale fuel or oil leakage could occur and any incidents would be small and easily contained before substances could leak into the underlying sediments and bedrock. The potential impact to soils/subsoils and bedrock from a fuel/oil leak or spill is considered to be negligible (adverse) and the significance of the effect is considered to be *Imperceptible,* for either cable route option.

A recreational amenity trail is proposed within the northern cluster of the Site. This trail will utilise an existing trail around and across Fossy Mountain and connect to other existing trails in the vicinity while also linking the town of Timahoe to Fossy Mountain. The construction works associated with the recreational amenity trail will be undertaken once the turbines (and associated infrastructure) is constructed and the cable route lain. It is expected that these works will be conducted over a 12 month period.

The proposed amenity trail will connect several existing trails in the area, it is considered that this can be scoped out for further consideration in terms of land use as there is no material change to land use.

The nature of the works which will involve largely improving existing trails and will involve minimal disturbance to soils and subsoils with little potential for any leaks/spills from mechanical plant (including to bedrock). The potential impact to soils and subsoils and bedrock is considered to be negligible (adverse) and the significance of the effect is considered to be *Imperceptible.*

Table 8-7 Evaluation of Initial Construction Impacts and their Effect Significance

Project Phase	Receptor	Sensitivity	Source of Impact/Description of Change*	Impact Magnitude*	Level of Effect *
Construction	Land	Low	Forestry land loss within Site. Replanting elsewhere within the State.	Low (Adverse) (turbines (and associated infrastructure) and meteorological mast)	Slight (Adverse) (turbines (and associated infrastructure))
			Temporary disruption to land use as cable route is lain.	Negligible (Cable Route)	Slight (Cable Route)
Construction	Soil and subsoil	Low	Material (soils, subsoils) will be required to be excavated at the turbine locations, access tracks and within the borrow pit. Permanent loss but excavated material will remain onsite and will be reused to build infrastructure items such as access tracks, turbine, hardstanding and substation foundations. In the case of the cable route, soils and subsoils will be removed but will be reused during backfilling of the trenches. For the amenity trail, this is predominantly an improvement of existing trails and will require minimal disturbance to soils and subsoils.	Low (Adverse) (turbines (and associated infrastructure), meteorological mast and Cable Route)	Slight (Adverse) (turbines (and associated infrastructure), meteorological mast and Cable Route)
				Negligible (Adverse) (Amenity Trail)	Imperceptible (Adverse) (Amenity Trail)

Project Phase	Receptor	Sensitivity	Source of Impact/Description of Change*	Impact Magnitude*	Level of Effect *
			Fuel and oil spills and leaks to soils and subsoils during construction within the Site and along the cable route or amenity trail	Low (Adverse) (turbines (and associated infrastructure) and Cable Route)	Slight (Adverse) (turbines (and associated infrastructure) and Cable Route)
				Negligible (Adverse) (Amenity Trail)	Imperceptible (Adverse) (Amenity Trail)
Construction	Bedrock geology (as an insitu feature)	Low	Fuel and oil spills and leaks during construction and along the cable route or amenity trail	Low (Adverse) (turbines (and associated infrastructure), TDR and Cable Route)	Slight (Adverse) (turbines (and associated infrastructure), TDR and Cable Route)
				Negligible (Adverse) (Amenity Trail)	Imperceptible (Adverse) (Amenity Trail)
Construction	Human health/built structure	High	Historical coal workings interacting with either workers during turbine construction	Negligible (Adverse)	Slight (Adverse)

Potential Effects – Operational

Table 8-8, below, summarises the potential effects discussed in the following subsections.

8.8.1.3 Turbines (and Associated Infrastructure) and TDR and Meteorological Mast

During the operational phase of the Proposed Development, there will be no new direct effects to land, soils, subsoils and bedrock due to the Proposed Development. Routine site maintenance of the turbines (and associated infrastructure) and Meteorological Mast will be undertaken which has the potential to indirectly effect soils, subsoils and bedrock at the Site. However, given there will be no exposed excavations and a small number of vehicles/equipment required for maintenance, the magnitude of impact from fuel and oil leaks and spills is considered to be negligible and the potential significance of effect is considered to be *Imperceptible*.

8.8.1.4 Cable Route and Recreational Amenity Trail

Similarly, to the operational phase associated with the turbines (and associated infrastructure) and TDR, the operational phase for the cable route and amenity trail will have no new direct effects on land, soils. subsoils or bedrock. Routine site maintenance will also be required for the cable route and the magnitude of impact from fuel and oil leaks and spills is considered to be negligible and the potential significance of effect is considered to be *Imperceptible* to soils, subsoils and geology.

Table 8-8 Evaluation of Initial Operational Impacts and their Effect Significance

Project Phase	Receptor	Sensitivity	Source of Impact/Description of Change*	Impact Magnitude*	Level of Effect *
Operations	Soils, subsoils	Low	Fuel and other substance leaks and spills from machinery and plant onsite	Negligible (Adverse)	Imperceptible
Operations	Bedrock geology	Low (as an insitu feature)	Fuel and other substance leaks and spills from machinery and plant onsite	Negligible (Adverse)	Imperceptible

8.8.2 Potential Effects – Decommissioning

Table 8-9, below, summarises the potential effects discussed in the following subsections.

The Proposed Development seeks a 35-year operational period. Wind turbines may, subject to planning permission, be replaced with a new set of turbines or the Site may be decommissioned. Consideration will be given here in the following subsections to the potential effects arising from decommissioning of the Site.

Turbines (and Associated Infrastructure) and TDR and Meteorological Mast

Decommissioning of the cable route cranes will disassemble the above grounds turbine components which will be removed off site for recycling.

The foundations will be covered over and allowed to re-vegetate naturally. Leaving turbine foundations in situ is considered a more environmentally sensible option is to remove the

reinforced concrete associated with each turbine would result in environmental nuisances such as noise and vibration and dust. It is proposed that the internal Site access tracks will be left in situ, subject to agreement with Laois County Council and the relevant landowners. It is envisaged that the remaining wider forestry would still be in-situ during the decommissioning phase and the most suitable land use would be a return to forestry. Similarly, to the construction and operation phases, machinery and plant operating in the Site areas represents a potential fuel and oil spill risk.

The potential impact of this decommissioning and return to a forestry land use is considered to be negligible and the potential significance of effect is considered to be *Slight*.

Cable Route and Recreational Amenity Trail

Underground cabling will be cut back and left in situ. Checks will be carried out to ensure that no environmental risk remain when the cabling is left behind.

The potential impact of this decommissioning on soils, subsoils and bedrock geology use is considered to be negligible and the potential significance of effect is considered to be *Slight*.

There is no proposed closure phase for the amenity trail and this is scoped out for further consideration here.

Table 8-9 Evaluation of Initial Decommissioning Phase Impacts and their Effect Significance

Project Phase	Receptor	Sensitivity	Source of Impact/Description of Change*	Impact Magnitude*	Level of Effect *
Decommissioning	Land	Low	Return to forestry usage	Negligible (Beneficial)	Slight
Decommissioning	Soils, subsoils	Low	Fuel and other substance leaks and spills from machinery and plant onsite	Negligible (Adverse)	Slight
Decommissioning	Bedrock geology	Low (as an insitu feature)	Fuel and other substance leaks and spills from machinery and plant onsite	Negligible (Adverse)	Slight

8.9 Cumulative Effects

In terms of all proposed and permitted developments within vicinity of the Site, the details of projects considered in the cumulative assessment are presented in Technical Appendix 1.2 'Projects Considered in the Cumulative Assessment'. In addition, a search of the National Planning Map Viewer (myplan.ie) indicates that there are no other major planned developments in the vicinity of the Site or on surrounding lands that have recently been granted planning permission and have the potential to give rise to any significant adverse cumulative impacts on land, soils, and geology in the local area. In addition,

8.10 Mitigation Measures

8.10.2 Mitigation Measures - Construction

Turbines (and Associated Infrastructure) and Cable Route and Meteorological Mast

The following mitigation measures will be implemented in full during the construction phase:

- Site operations will be managed in accordance with relevant health and Safety legislation (Safety, Health & Welfare at Work Act (2005, as amended);
- Construction phase activities will take place in accordance with the Construction Environmental Management Plan (CEMP);
- Fencing will be maintained at the Site to ensure that the risk of injury to the public and livestock is minimised;
- Stockpiles will be evaluated and monitored and kept stable for safety and to minimise erosion;
- Permission will be sought from the Forestry Service to replant lands to compensate the loss of forestry land within the Site area by replanting forestry at an alternative site within the State;
- In order to reduce the risk of localised erosion (and potential dust emissions) during the excavation and infilling, the area of bare or exposed soils and rock will be kept to a minimum, insofar as practicable, by progressive restoration of final and backfilled surfaces. Where required, stockpiled soils (pending re-use) or exposed surfaces (pending further backfilling to final ground level) will be temporarily covered; and
- All aspects of the proposed backfilling / construction phase works will be undertaken in accordance with relevant best practice environmental guidance published by the Environmental Protection Agency and other regulatory agencies. All activities will be undertaken in accordance with the provisions in the Waste Management Act 1996 (as amended).

The proposed mitigation measures to deal with potential fuel / oil spills include the following:

- Ensuring that any refuelling of mobile plant undertaken within the Site is only undertaken using double skinned bowsers;
- No oils, greases, hydraulic fluids or hazardous substances (or any associated wastes) will be stored across the Site. All such materials will be stored under cover, over fuel spill trays / bunded containers within designated storage areas within the construction compounds;
- Good site management practices will be implemented to reduce risks of spills, including regular monitoring and inspection of storage vessels and regular maintenance and servicing of construction plant and equipment;
- The Applicant will ensure that such plant and resources as are necessary to ensure that the Site will be managed and operated in accordance with best

waste management practice and that activities comply fully with environmental management systems and planning consents; and

- Contingency plans / procedures will be developed to deal with potential leaks and spills. An emergency spill response kit will be held on Site.

Turbines and Associated Infrastructure Only

- Further construction phase site investigations (including borehole drilling) will be undertaken, the construction phase site investigations will confirm if the features present near to turbine location T8 are shafts and adits associated with historical coal mining or lithological differences in clay/sand/gravel distribution; and
- Should these be confirmed as historical mining features at construction phase near T8, consideration will be given to their stability and the need for piling or other suitable engineering controls beneath turbine location T8.

8.10.3 Mitigation Measures - Operation

Turbines and Associated Infrastructure, Cable Route, Recreational Amenity Trail and Meteorological Mast

Site operations will be managed in accordance with relevant health and Safety legislation (Safety, Health & Welfare at Work Act (2005, as amended);

In order to reduce the risk of localised erosion (and potential dust emissions) during the excavation and infilling, the area of bare or exposed soils and rock will be kept to a minimum, insofar as practicable, by progressive restoration of final and backfilled surfaces. Where required, consideration can also be given to establishing temporary vegetation cover over stockpiled soils (pending re-use) or exposed surfaces (pending further backfilling to final ground level); and

All aspects of the proposed backfilling / construction phase works will be undertaken in accordance with relevant best practice environmental guidance published by the Environmental Protection Agency and other regulatory agencies. All activities will be undertaken in accordance with the provisions in the Waste Management Act 1996 (as amended).

The proposed mitigation measures to deal with potential fuel / oil spills include the following:

- Ensuring that any refuelling of mobile plant undertaken within the Site is only undertaken using double skinned bowsers;
- No oils, greases, hydraulic fluids or hazardous substances (or any associated wastes) will be stored across the Site. All such materials will be stored under cover, over fuel spill trays / bunded containers within designated storage areas within the construction compounds;
- Good site management practices will be implemented to reduce risks of spills, including regular monitoring and inspection of storage vessels and regular maintenance and servicing of construction plant and equipment;

- The Applicant will ensure that such plant and resources as are necessary to ensure that the Site will be managed and operated in accordance with best waste management practice and that activities comply fully with environmental management systems and planning consents; and
- Contingency plans / procedures will be developed to deal with potential leaks and spills. An emergency spill response kit will be held on Site.

8.10.4 Mitigation Measures - Decommissioning

Turbines and Associated Infrastructure and Cable Route

Site operations will be managed in accordance with relevant health and Safety legislation (Safety, Health & Welfare at Work Act (2005, as amended);

Stockpiles will be evaluated and monitored and kept stable for safety and to minimise erosion; and

Fencing will be maintained at the Site to ensure that the risk of injury to the public and livestock is minimised.

The proposed mitigation measures to deal with potential fuel / oil spills include the following :

- Ensuring that any refuelling of mobile plant undertaken within the Site is only undertaken using double skinned bowsers;
- No oils, greases, hydraulic fluids or hazardous substances (or any associated wastes) will be stored across the Site. All such materials will be stored under cover, over fuel spill trays / bunded containers within designated storage areas within the construction compounds;
- Good site management practices will be implemented to reduce risks of spills, including regular monitoring and inspection of storage vessels and regular maintenance and servicing of construction plant and equipment;
- The Applicant will ensure that such plant and resources as are necessary to ensure that the Site will be managed and operated in accordance with best waste management practice and that activities comply fully with environmental management systems and planning consents; and
- Contingency plans / procedures will be developed to deal with potential leaks and spills. An emergency spill response kit will be held on Site.

In order to reduce the risk of localised erosion (and potential dust emissions) during the excavation and infilling, the area of bare or exposed soils and rock will be kept to a minimum, insofar as practicable, by progressive restoration of final and backfilled surfaces. Where required, stockpiled soils (pending re-use) or exposed surfaces (pending further backfilling to final ground level) will be temporarily vegetated; and

All aspects of the proposed backfilling / operation phase works will be undertaken in accordance with relevant best practice environmental guidance published by the Environmental Protection Agency and other regulatory agencies. All activities will be undertaken in accordance with the provisions in the Waste Management Act (1996) as amended.

8.11 'Do-Nothing Scenario'

The Do-Nothing scenario relevant to land, soils and geology is one where the Proposed Development does not go ahead and the Site will continue to be predominantly in conifer forestry use. No soils or geology would be extracted from the Site and no clearance of forestry (beyond normal felling and replanting) would occur.

8.12 Residual Impact Assessment

8.12.2 Residual Effects - Construction

Turbines and Associated Infrastructure and Meteorological Mast

With the implementation of the proposed mitigation measures, it is considered that the potential effects of fuel spill on soils and bedrock, will reduce to *Imperceptible* for both the turbines (and associated infrastructure) and meteorological mast.

Residual effects for land from land use change will remain at *Slight* as land use will remain changed in the locality for both the turbines (and associated infrastructure) and meteorological mast.

The residual effects for soils and subsoils through the loss of material in excavation is considered to be unchanged at *Slight*. Excavation of soils and subsoils is using the available resource onsite and this will be reused onsite for the turbines (and associated infrastructure) and meteorological mast. However, there will be a loss of in situ material which cannot be offset for the turbines (and associated infrastructure) and meteorological mast.

The residual effect of the coal mine shafts will remain at *Slight,* as with the matrix approach for calculating significance of effect, the receptor (workers during construction of the turbines) remains a high value receptor. The impact also remains negligible with mitigation measures applied as no further reduction is possible. However, with the proposed mitigation measures, the likelihood of the potential residual effect occurring is highly unlikely.

Cable Route and Recreational Amenity Trail

The residual effects for soils with the implementation of mitigation measures for either of the cable route options, is considered to reduce to *Imperceptible* for potential impacts from oils and fuel leaks. The residual effect will remain as *Slight (adverse)* from excavation works. Excavation of soils and subsoils is using the available resource onsite and this will be reused for the cable route and amenity trail. However, there will be a loss of in situ material which cannot be offset. Residual effects for land from land use disturbance will remain at *Slight (adverse)* for either of the cable route options.

The residual effects for the amenity trail for disturbance to soils and subsoils and potential fuel and oil leaks/spills to soils, subsoil or bedrock will remain at *Imperceptible* with the implementation of mitigation measures.

8.12.3 Residual Effects - Operations

Turbines and Associated Infrastructure and TDR and Meteorological Mast

The residual effect to soils and bedrock through the indirect impact of leaks and spills is considered to be *Imperceptible*, or unchanged from the initial assessment for both the turbines (and associated infrastructure) and TDR.

Cable Route and Recreational Amenity Trail

The residual effect to soils and bedrock through the indirect impact of leaks and spills is considered to be *Imperceptible*, or unchanged from the initial assessment for either of the cable route options and amenity trail.

8.12.4 Residual Effects - Decommissioning

Turbines and Associated Infrastructure and TDR and Meteorological Mast

With the implementation of the proposed mitigation measures, it is considered that the potential effects of fuel spill on soils and bedrock, will reduce to *Imperceptible* for both the wind farm and TDR.

Cable Route

With the implementation of the proposed mitigation measures, it is considered that the potential effects of fuel spill on soils and bedrock, will reduce to *Imperceptible*.

8.13 Unplanned Events

Unplanned events within the Site have the potential to impact on the land, soils and geology at the Site. In the context of the Proposed Development, ground instability is considered to be the main disaster/accident that could be associated with the Proposed Development. Commonly it would be a risk associated with wind farms located in peatland, however, the Site here has no peat cover, and this has been scoped out as a potential cause of a failure event.

In the context of the Site and known history, it is considered that a previously unmapped and unidentified coal shaft or adit could lead to an unplanned ground instability event at the Site. However, it is considered that the failure would be gradual in nature and develop over time. Advance warning signs of the failure such as cracking, change in levels or slumping of the foundations and concrete bases associated with the wind turbines would be visible during site inspections and standard maintenance works. Should there be indications of a potential instability concern, remedial measures could be implemented to prevent a failure event.

It is considered that the potential effects of such an event would be Not Significant.

8.14 Monitoring

During the construction phase, site investigative works will be undertaken and this will include inspection and monitoring of the ground conditions. The findings of the site investigation works will be used to determine if frequent site inspections are required throughout the operational phase of the Proposed Development. It is proposed that

monitoring of ground conditions at the turbines (and associated infrastructure) should be undertaken annually, subject to confirmation using the findings of the detailed construction phase site investigation works.

8.15 Difficulties Encountered

No particular difficulties were encountered in undertaking this assessment of soils, land and geology.

8.16 References

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Option 2

Option 1

T1 T2 T3 T4 T5 T6 T7 T8 T9 T10 T11 T12 T13

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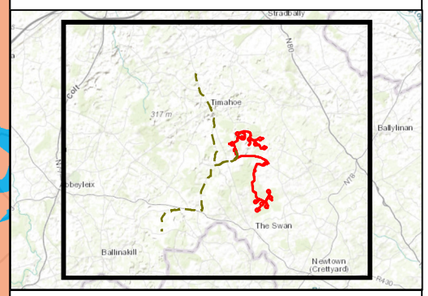
Kilometres

LEGEND

- Proposed Development Site Boundary
- Proposed Turbine Layout
- Proposed Substation Compound
- Proposed Temporary Construction Compound
- Proposed Borrow Pit
- Proposed Hardstanding
- Proposed Access
- Proposed Met Mast Hardstanding
- Proposed Cable Routes to be Assessed (Separate Planning
- Proposed Development Site Boundary and Proposed Cable Routes 2 km Buffer

Irish Soil Information System - National Soils

- 01xx - Peat
- 0360a - Crush
- 05RIV - River
- 0650a - Mylerstown
- 0700b - Kilrush
- 0760c - Howardstown
- 1000a - Elton
- 1000c - Elton
- 1030a - Crosstown
- 1100e - Ballylanders
- 1150a - Baggotstwon
- Urban



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COOLGLASS WIND FARM
ENVIRONMENTAL IMPACT
ASSESSMENT REPORT

LAND, SOILS AND GEOLOGY

NATIONAL SOILS OVERVIEW

FIGURE 8-1-a

Scale	Date
1:60,000 @ A3	JUNE 2023

02036.00787.0094.0 National Soils

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community. Irish National Soils Map, 1:250,000k, V1b(2014).Teagasc, Cranfield University.Jointly funded by the EPA STRIVE Research Programme 2007-2013 and Teagasc.

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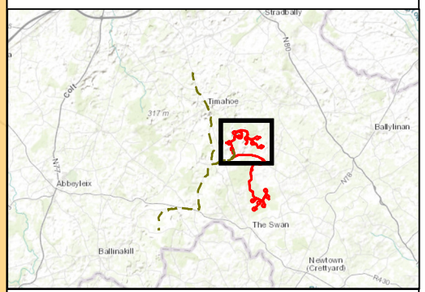
Kilometres

LEGEND

- Proposed Development Site Boundary
- Proposed Turbine Layout
- Proposed Substation Compound
- Proposed Temporary Construction Compound
- Proposed Borrow Pit
- Proposed Hardstanding
- Proposed Access
- Proposed Met Mast Hardstanding
- Proposed Cable Routes to be Assessed (Separate Planning

Irish Soil Information System - National Soils

- 05RIV - River
- 0760c - Howardstown
- 1030a - Crosstown
- 1100e - Ballylanders



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LAND, SOILS AND GEOLOGY

NATIONAL SOILS NORTHERN CLUSTER

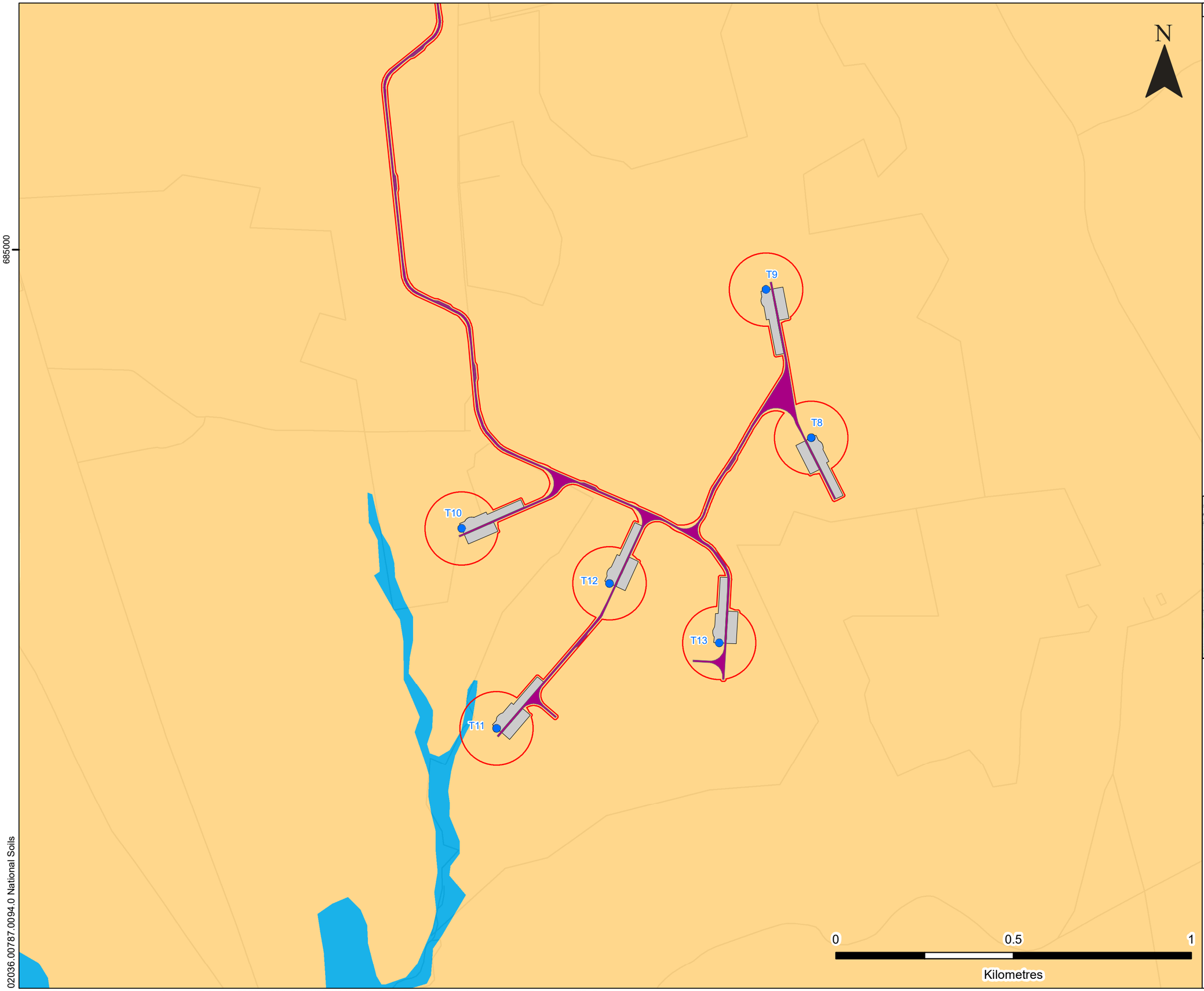
FIGURE 8-1-b

Scale: 1:10,000 @ A3

Date: JUNE 2023

02036.00787.0094.0 National Soils

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community. Irish National Soils Map, 1:250,000k, V1b(2014).Teagasc, Cranfield University.Jointly funded by the EPA STRIVE Research Programme 2007-2013 and Teagasc.

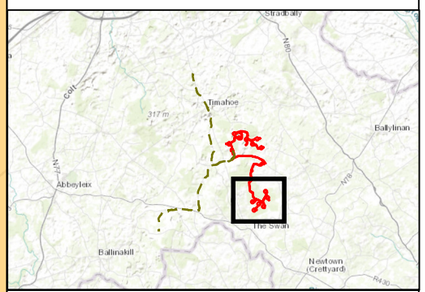


LEGEND

- Proposed Development Site Boundary
- Proposed Turbine Layout
- Proposed Hardstanding
- Proposed Access

Irish Soil Information System - National Soils

- 05RIV - River
- 1030a - Crosstown
- 1100e - Ballylanders



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LAND, SOILS AND GEOLOGY

NATIONAL SOILS
SOUTHERN CLUSTER

FIGURE 8-1-c

Scale: 1:10,000 @ A3

Date: JUNE 2023

02036.00787.0094.0 National Soils

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community. Irish National Soils Map, 1:250,000k, V1b(2014).Teagasc, Cranfield University.Jointly funded by the EPA STRIVE Research Programme 2007-2013 and Teagasc.

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Option 2

Option 1

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Kilometres

LEGEND

- Proposed Development Site Boundary
- Proposed Turbine Layout
- Proposed Substation Compound
- Proposed Temporary Construction Compound
- Proposed Borrow Pit
- Proposed Hardstanding
- Proposed Access Track
- Proposed Met Mast Hardstanding
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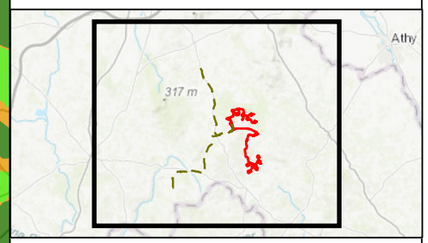
Environmental Protection Agency - Subsoils

- A - Alluvium Undifferntiated Graveely
- BasEsk- Basic Esker Sands and Gravels
- BktPt - Blanket Peat
- Cut - Cutover Peat
- FenPt - Fen Peat
- GLs - Limestone Sands and Gravels Carboniferous
- GNSSs - Shales and Sandstone Sands and Gravels Namurian
- KaRck - Karstified Limestone Bedrock at Surface
- L - Lake Sediment Undifferentiated
- Made - Ground
- Rck- Bedrock at Surface
- TDSs - Sandstone Till Devonian
- TLs - Limestone Till Carboniferous
- TNSSs - Shales and Sandstones Till (Namurian)
- Water



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LAND, SOILS AND GEOLOGY

NATIONAL SUBSOILS OVERVIEW

FIGURE 8-2-a

Scale 1:60,000 @ A3

Date JUNE 2023

02036.00787.0095.0 National Subsoils

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LEGEND

- Proposed Development Site Boundary
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- Proposed Access Track
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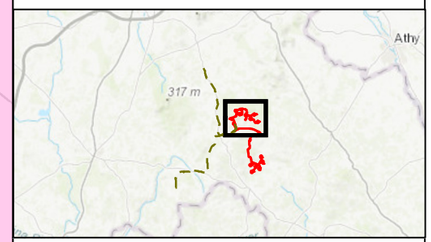
Environmental Protection Agency - Subsoils

- A - Alluvium Undifferntiated Graveely
- GLs - Limestone Sands and Gravels Carboniferous
- Rck- Bedrock at Surface
- TLs - Limestone Till Carboniferous
- TNSSs - Shales and Sandstones Till (Namurian)



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LAND, SOILS AND GEOLOGY

NATIONAL SUBSOILS
NORTHERN CLUSTER

FIGURE 8-2-b

Scale: 1:10,000 @ A3
Date: JUNE 2023

02036.00787.0095.0 National Subsoils

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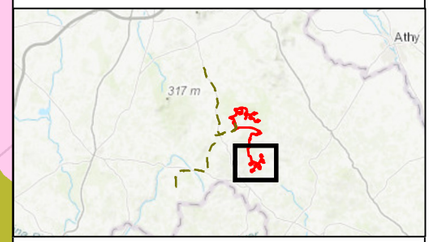
LEGEND

- Proposed Development Site Boundary
- Proposed Turbine Layout
- Proposed Hardstanding
- Proposed Access Track

Environmental Protection Agency - Subsoils

- A - Alluvium Undifferntiated Graveely
- Rck- Bedrock at Surface
- TNSSs - Shales and Sandstones Till (Namurian)



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LAND, SOILS AND GEOLOGY

**NATIONAL SUBSOILS
SOUTHERN CLUSTER**

FIGURE 8-2-c

Scale 1:10,000 @ A3

Date JUNE 2023

02036.00787.0095.0 National Subsoils

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Option 2

Option 1

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Kilometres

LEGEND

- Proposed Development Site Boundary
- Proposed Turbine Layout
- Proposed Substation Compound
- Proposed Temporary Construction Compound
- Proposed Borrow Pit
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- Proposed Access Track
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- Proposed Development Site Boundary and Proposed Cable Routes 2 km Buffer

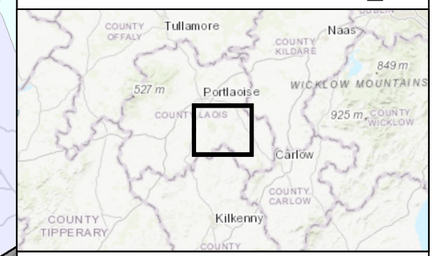
Bedrock Geology - Linear Features

- Fault
- Thin Stratigraphical Unit, Diagrammatic
- Unconformity, Dots on Younger Side

Bedrock Geology

CARBONIFEROUS

- Aghmacart Formation
- Allenwood Formation
- Ballyadams Formation
- Ballysteen Formation
- Clogrenan Formation
- Crosspatrick Formation
- Bregaun Flagstone Formation
- Killeshin Siltstone Formation
- Luggacurren Shale Formation
- Clay Gall Sandstone Formation
- Coolbaun Formation
- Swan Sandstone Member
- Moyadd Coal Formation



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LAND, SOILS AND GEOLOGY

BEDROCK GEOLOGY

FIGURE 8-3

Scale 1:60,000 @ A3

Date JUNE 2023

02036.00787.0096.0 Bedrock Geology

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LS029 LS030 LS033 LS033 LS033 LS018 LS003 LS009 LS021 LS021 LS020 LS024 LS025 LS001 LS006 KK014 LS012 LS007 LS011

T1 T2 T3 T4 T5 T6 T7 T8 T9 T10 T11 T12 T13

Option 2

Option 1

N77 L7832 R427 N80 R428 L3837 R426 L3839 L4006 L3953 R425 L3956 L3838 L3839 L3960 L2715 L3777 L7853 L7797 L2778 L7721 L3850 L3855 N78 L3856 L3859 L3870 L3858 R430 L77921 L7860 L7872 R432 L7797 L1738

Togher Wood Colt Wood Cashel Bog Rock of Cashel Oughavol Wood Carrig Hill County Laois Timahoe Cullenagh Mountain 317 m Ballyroan Fossy Hill Cooper's Hill Knockardagur The Swan Ballinakill

LEGEND

- Proposed Development Site Boundary
- Proposed Turbine Layout
- Proposed Substation Compound
- Proposed Temporary Construction Compound
- Proposed Borrow Pit
- Proposed Hardstanding
- Proposed Access Track
- Proposed Met Mast Hardstanding
- Proposed Cable Routes to be Assessed (Separate Planning Application)
- Proposed Development Site Boundary and Proposed Cable Routes 2 km Buffer
- Geoheritage Site

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02036.00787.0097.0 Geological Heritage

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ASSESSMENT REPORT

LAND, SOILS AND GEOLOGY

GEOLOGICAL HERITAGE

FIGURE 8-4

Scale 1:60,000 @ A3

Date JUNE 2023

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LEGEND

- Proposed Development Site Boundary
- Proposed Turbine Layout
- Proposed Substation Compound
- Proposed Temporary Construction Compound
- Proposed Borrow Pit
- Proposed Hardstanding
- Proposed Access Track
- Proposed Met Mast Hardstanding
- Proposed Cable Routes to be Assessed (Separate Planning Application)
- Proposed Development Site Boundary and Proposed Cable Routes 2 km Buffer

Historical Coal Workings

- Colliery
- Disused Coal Shaft
- Pump
- Quarry Pit

Option 1

Option 2

T1 T2 T3 T4 T5 T6 T7 T8 T9 T10 T11 T12 T13

Timahoe Cullenagh Mountain 317 m Fossy Hill Rock of Cashel Cooper's Hill Knockardagur Ballyroan Ballinakill The Swan Oughavol Wood Carrig Hill Togher Wood Colt Wood Cashel Bog

N77 L7832 R427 R426 L3837 N80 R428 L3839 R425 L4006 L3953 L3956 L2715 L3777 L3838 L3839 L3960 L7853 L2778 L7797 L3851 L3850 N78 L3855 L3856 L3859 L3858 L3870 L78721 R430 R432 L77921 L7860 L7872 L1738

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LAND, SOILS AND GEOLOGY

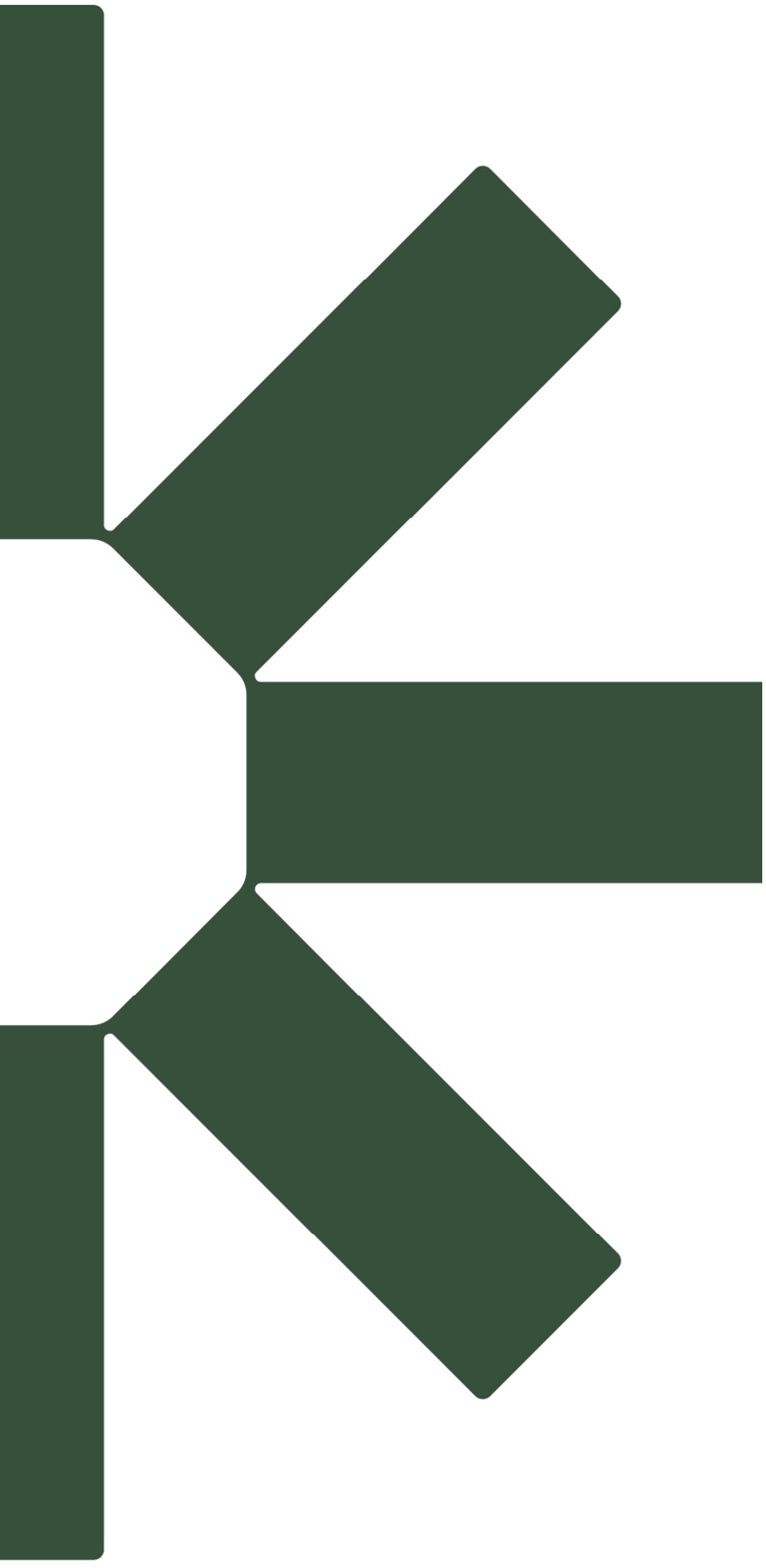
HISTORICAL COAL WORKINGS

FIGURE 8-5

Scale 1:60,000 @ A3

Date JUNE 2023

02036.00787.0098.0 Historic Coal Workings



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