8. LAND SOILS AND GEOLOGY

8.1 Introduction

8.1.1 Background and Objectives

Hydro-Environmental Services (HES) was engaged by MKO to carry out an assessment of the potential likely and significant effects of the Proposed Wind Farm and Proposed Grid Connection (Proposed Project) at Borrisbeg and adjacent townlands, near Templemore, Co. Tipperary on Land, Soils and Geology aspects of the receiving environment.

For the purposes of this EIAR:

- The '**Proposed Wind Farm'** refers to the 9 no. turbines and supporting infrastructure which is the subject of this Section 37E application.
- The '**Proposed Grid Connection'** refers to the 110kV substation and supporting infrastructure which will be the subject of a separate Section 182A application.
- The '**Proposed Project'** comprises the Proposed Wind Farm and the Proposed Grid Connection, all of which are located within the EIAR Study Boundary (the '**Site**') and assessed together within this EIAR.

Please see section 1.1.1 of this EIAR for further details. A detailed description of the Proposed Project is provided in Chapter 4 of this EIAR.

This report provides a baseline assessment of the environmental setting of the Proposed Project, as described in Chapter 4, in terms of Land, Soils and Geology and discusses the potential likely significant effects that the construction, operation and decommissioning of the Proposed Project may have. Where required, appropriate mitigation measures to avoid any identified significant effects to Land, Soils and Geology (i.e., natural resources) are recommended and the residual effects of the Proposed Project post-mitigation are assessed.

The Land, Soils and Geology Study Area is defined by the EIAR Study Area Boundary or 'Site'.

8.1.2 Statement of Authority

Hydro-Environmental Services (HES) are a specialist geological, hydrological, hydrogeological and environmental practice which delivers a range of water and environmental management consultancy services to the private and public sectors across Ireland and Northern Ireland. HES was established in 2005, and our office is located in Dungarvan, County Waterford.

Our core areas of expertise and experience includes soils, subsoils and geology. We routinely complete impact assessments for land, soils and geology, hydrology and hydrogeology for a large variety of project types including wind farms and renewable energy projects.

This chapter of the EIAR was prepared by Michael Gill, David Broderick and Jenny Law.

David Broderick P.Geo (BSc, H. Dip Env Eng, MSc) is a Hydrogeologist with over 17 years' experience in both the public and private sectors. Having spent two years working in the Geological Survey of Ireland working mainly on groundwater and source protection studies David moved into the private sector. David has a strong background in groundwater resource assessment and geological, hydrogeological/hydrological investigations in relation to developments such as quarries and wind farms. David has completed numerous geology and water sections for input into EIARs for a range of

commercial developments. David has worked on over 80+ other wind farm related projects across the country.

Michael Gill P.Geo (BA, BAI, Dip Geol., MSc, MIEI) is an Environmental Engineer and Hydrogeologist with over 22 years' environmental consultancy experience in Ireland. Michael has completed numerous land, soils and geology impact assessments of wind farms and renewable projects in Ireland. In addition, he has substantial experience in geological characterisation, peatland morphology, and surface water drainage design and SUDs design and surface water/groundwater interactions. Michael has worked on over 100+ other wind farm related projects across the country.

Jenny Law (BSc, Msc) is an Environmental Geoscientist who has almost 2 years' experience, has been involved in the preparation of Environmental Impact Assessment Reports (EIARs) for numerous projects including wind farms and commercial and housing developments. Jenny has also completed several Water Framework Directive Assessments and Flood Risk Assessments for various project types.

8.1.3 Relevant Legislation

The EIAR is prepared in accordance with the requirements of European Union Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (the 'EIA Directive') as amended by Directive 2014/52/EU. The requirements of the following legislation are complied with:

- Planning and Development Acts, 2000-2021;
- Planning and Development Regulations, 2001 (as amended);
- Directives 2011/92/EU and 2014/52/EU on the assessment of the effects of certain public and private projects on the environment;
- S.I. No. 296/2018 European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018; and,
- The Heritage Act 1995, as amended.

8.1.4 Relevant Guidance

The Land, Soils and Geology chapter of this EIAR was prepared in accordance with, where relevant, the guidance contained in the following documents:

- Environmental Protection Agency (2022): Guidelines on the Information to be contained in Environmental Impact Assessment Reports;
- Institute of Geologists Ireland (2013): Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements;
- National Roads Authority (2008): Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;
- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (DoHPLG, 2018); and,
- Guidance on the preparation of the EIA Report (Directive 2011/92/EU as amended by 2014/52/EU), (European Commission 2017).

8.2 Assessment Methodology

8.2.1 Desk Study

A desk study of the Proposed Project site and land, soils and geology receiving environment was completed in advance of undertaking the walkover survey and site investigations. This involved collecting all relevant geological data for the Study Area. This included consultation with the following data sources:

- Environmental Protection Agency database (www.epa.ie);
- Geological Survey of Ireland - Groundwater and Geology Databases (www.gsi.ie);
- Geological Survey of Ireland – Geological Heritage site mapping (www.gsi.ie);
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 18 (Geology of Tipperary). Geological Survey of Ireland (GSI, 1996);
- Geological Survey of Ireland – 1:25,000 Field Mapping Sheets;
- General Soil Map of Ireland 2nd edition (www.epa.ie); and,
- Aerial Photography, 1:5000- and 6-inch base mapping.

8.2.2 Baseline Monitoring and Site Investigations

A walkover survey, including geological mapping and investigations of the Proposed Project site, were undertaken by David Broderick and Jenny Law of HES (refer to Section 8.1.2 above for qualifications and experience) on 8th November 2022, 3rd, 4th, 10th, 11th & 20th July 2023 and 29th September 2023.

A comprehensive geological dataset has been collected as part of this EIAR study. Intrusive site investigations were completed at the Proposed Wind Farm site in July 2023, by Peterson Drilling Services Ltd and HES.

In summary, site investigations to address the Land, Soils and Geology chapter of the EIAR included the following:

- A total of 143 no. soil probes/investigations points were carried out by MKO to investigate the presence of peat at the Site;
- 23 no. of the above soil probes were carried out along the Grid Connection and end masts;
- Trial pitting (16 no.) to investigate underlying mineral soil lithology and the subsoil/bedrock interface;
- 3 no. investigation boreholes were completed by Peterson Drilling Services Ltd on 10th & 11th July 2023 to investigate the full geological profile of the Site;
- Particle Size Distribution (PSD) of 4 no. soil samples recovered from the trial pits;
- Logging of subsoil exposures across the site where mineral soils and peat profiles are exposed; and,
- Mineral subsoils and peat were logged according to BS: 5930 and Von Post Scale respectively.

8.2.3 Scope and Consultation

The scope for this EIAR has been informed by consultation with statutory consultees, bodies with environmental responsibility and other interested parties. This consultation process is outlined in Section 2.6 of this EIAR.

The Geological Survey of Ireland was the only consultee to respond with respect to Land, Soils and Geology and their response was informative in nature with regard sources of online data for baseline assessment purposes.

8.2.4 Limitations and Difficulties Encountered

No limitations or difficulties were encountered during the preparation of the Land, Soils and Geology Chapter of the EIAR. The investigations carried out at the Proposed Project site for the purpose of the EIAR and planning application are very thorough.

8.2.5 Impact Assessment Methodology

Using information from the desk study and data from the site investigations, an assessment of the importance of the land, soil and geological environment within the wider area and Site is assessed using the criteria set out in Table 8-1, NRA 2008).

Table 8-1 Estimation of Importance of Soil and Geology Criteria (NRA, 2008).

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

Importance	Criteria	Typical Example
	scale. Volume of peat and/or soft organic soil underlying site is small on a local scale.	Poorly drained and/or low fertility soils. Uneconomically extractable mineral Resource.

The guideline criteria (EPA, 2022) for the assessment of likely significant effects require that likely effects are described with respect to their extent, magnitude, type (i.e. negative, positive or neutral) probability, duration, frequency, reversibility, and transfrontier nature (if applicable). The descriptors used in this environmental impact assessment report are those set out in the EPA (2022) Glossary of effects as shown in Chapter 1 of this EIAR. In addition, the two impact characteristics proximity and probability are described for each impact and these are defined in **Table 8-2**.

In order to provide an understanding of this descriptive system in terms of the geological/hydrological environment, elements of this system of description of effects are related to examples of potential likely significant effects on the geology and morphology of the existing environment, as listed in **Table 8-3**.

Table 8-2: Additional Impact Characteristics.

Impact Characteristic	Degree/ Nature	Description
Proximity	Direct	An impact which occurs within the area of the proposed project, as a direct result of the proposed project.
	Indirect	An impact which is caused by the interaction of effects, or by off-site developments.
Probability	Unlikely	The effects that can reasonably be expected to occur because of the planned project if all mitigation measures are properly implemented.
	Likely	The effects that can reasonably be expected not to occur because of the planned project if all mitigation measures are properly implemented.

Table 8-3: Impact descriptors related to the receiving environment.

Impact Characteristics		Potential Hydrological Impacts
Quality	Significance	
Negative only	Profound	Widespread permanent impact on: • The extent or morphology of a cSAC. • Regionally important aquifers. • Extents of floodplains. Mitigation measures are unlikely to remove such impacts.
Positive or Negative	Significant	Local or widespread time-dependent impacts on: • The extent or morphology of a cSAC / ecologically important area.

Impact Characteristics		Potential Hydrological Impacts
Quality	Significance	
		• A regionally important hydrogeological feature (or widespread effects to minor hydrogeological features). • Extent of floodplains. Widespread permanent impacts on the extent or morphology of an NHA/ecologically important area. Mitigation measures (to design) will reduce but not completely remove the impact – residual impacts will occur.
Positive or Negative	Moderate	Local time-dependent impacts on: • The extent or morphology of a cSAC / NHA / ecologically important area. • A minor hydrogeological feature. • Extent of floodplains. Mitigation measures can mitigate the impact OR residual impacts occur, but these are consistent with existing or emerging trends
Positive, Negative or Neutral	Slight	Local perceptible time-dependent impacts not requiring mitigation.
Neutral	Imperceptible	No impacts, or impacts which are beneath levels of perception, within normal bounds of variation, or within the bounds of measurement or forecasting error.

8.3 Existing Environment

8.3.1 Site Description and Topography

The Site is located approximately 2.5km northeast of the town of Templemore, Co. Tipperary, and to the east of the N62 which runs northerly between Templemore and Roscrea towns. Land coverage is predominantly agricultural fields, small scale commercial forestry and local roads, situated within the immediate valley of the River Suir channel which flows through the Site. Isolated dwellings and farmhouses are located along the N62 to the west of the site and along local roads to the east. Topography at the Site low-lying with flat to gently undulating ground. Ground elevations range from approximately 120m OD on the north to 105m OD on the south of the Site which is the direction of flow in the River Suir. In addition to an overall southerly slope, the ground also slopes gently towards the River Suir and its main local tributary, the Eastwood River which flow in a southerly direction through the Site. The main River Suir channel is located on the east of the Site while the Eastwood River is located on the west of the Site.

Turbines will be delivered from Dublin Port to the Site via the M7 and N62. The abnormal loads will exit the M7 at junction 22 and travel along the N62 for 9.4km where it will meet the proposed temporary abnormal load access into the Site. A temporary abnormal load road will be constructed through grassland for the delivery of large components down through the Site.

The proposed enhancement of a portion of the Eastwood River within the Site will involve the restoration of a previously deepened and straightened channel to appropriate dimensions, pattern and profile and the establishment of a native woodlands buffer. The section of the river channel proposed for enhancement is approximately 300m in length. The enhancement involves creating a more meandering channel with pools and riffles. The channel is located in a grassland area.

8.3.1.1 Proposed Grid Connection

The Proposed Grid Connection comprises a proposed onsite 110kV substation and temporary construction compound, an approx. 2km underground cable route connection and end mast towers which break into the existing 110kV Ikerrin to Thurles overhead line.

The proposed onsite substation is located within the southeast of the Site from which the proposed underground grid connection cable route briefly runs along the local road network (L7039), R433 & L7038) for approximately 870m, with the remainder of the route being within new access track through agricultural grassland for approximately 1.2km through grassland located to the north of the Cork – Dublin Railway line. The proposed 2 no. end masts are located in grassland located to the north of the Cork – Dublin Railway line, breaking the existing Ikerrin to Thurles 110kV overhead line.

8.3.2 Land and Land Use

Based on Corine (2018) mapping the Site and surrounding lands predominantly comprise agricultural pastures with the grid connection underground cabling route falling partially within local roads. No major land use changes have been recorded by Corine mapping (2018). Residential and commercial landuse is also found in the surrounding landscape.

8.3.3 GSI Mapped Peat/Soils and Subsoils

8.3.3.1.1 *Proposed Wind Farm*

The published soil map (www.epa.ie) for the area shows that majority of the Site is overlain by a mixture of poorly drained mineral soils (BminPD) mainly to the south and north, areas of cut peat towards the centre of the site, southeast and southwest and an area of deep well drained mineral soils (BminDW) at the very north of the site.

The GSI subsoil mapping shows that tills derived from limestones dominate the Site with areas of cutover raised peat located towards the centre of the site, southeast and southwest. Alluvium soils are mapped along the River Suir and its tributaries on the north and northeast of the site. Small pockets of Lacustrine sediments are mapped within the northwestern section of the Site.

Based on the GSI mapping, 6 no. turbine locations (T1, T2, T3, T5, T6 & T9) along with the majority of access roads, the temporary construction compound and borrow pit are located in areas of limestone tills while 3 no. turbines (T3, T4 and T7) and biodiversity enhancement area are located in areas mapped as cut peat. The presence of peat at the Site is discussed further in Section 8.3.5 below.

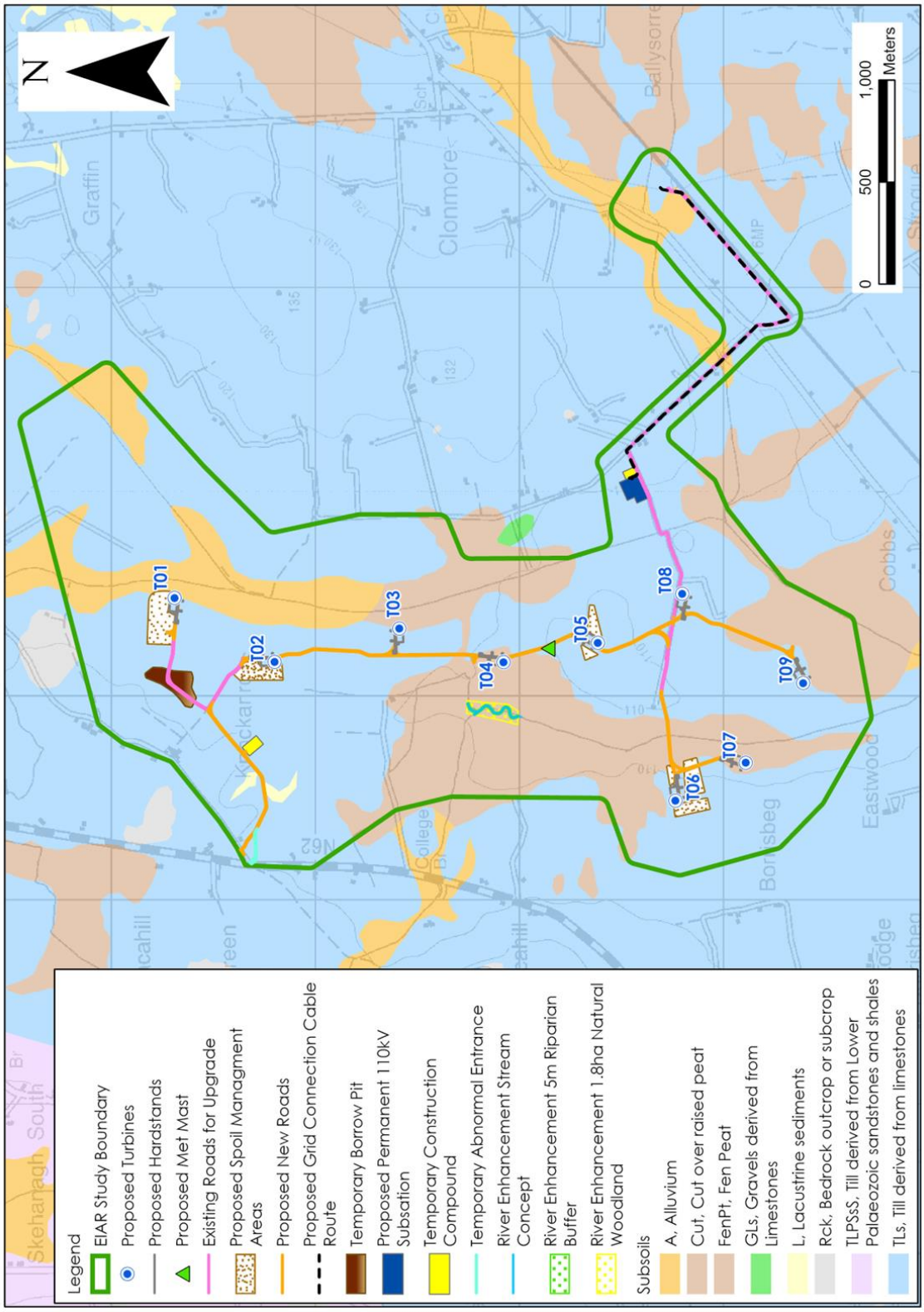
A subsoil geology map for the Site is shown as **Figure 8-1.**

8.3.3.1.2 *Proposed Grid Connection*

Mapped soils along the Grid Connection underground cabling route, the proposed end masts breaking the existing overhead line and the location of the proposed 110kV substation are mainly BminPD with some alluvium along the middle section of the proposed underground cabling route at the Clonmore River crossing. Subsoils are mapped as mainly limestone tills. Cutover raised peat is also mapped locally

in areas of the proposed underground cabling route but peat is not intercepted by the underground cabling route, proposed end masts or the proposed substation works.

Figure 8-1 Subsoils Geology Map



8.3.4 GSI Bedrock Geology Mapping

8.3.4.1 Proposed Wind Farm

Based on the GSI bedrock mapping, the bedrock formation underlying the Site consists of 3 no. main lithologies from the Dinantian series of the Carboniferous period. The north and northwestern section of the Site is underlain by Waulsortian Limestones which consist of massive, unbedded lime-mudstone. The proposed borrow pit is located in this area of the Site.

South of the Waulsortian Limestones, the Ballysteen Formation is mapped to underly the majority of the southern portion of the Wind Farm site. The Lisduff Oolite member, of the Ballysteen Formation, is mapped as a relatively thin band that extends from east to west across the middle of the Site.

The Ballysteen Formation comprises dark muddy limestone and shale. The Lisduff Oolite member that bands across the centre of the Site is approximately 400m in width and is described as a thickly bedded, pale-blue/grey, cross-bedded, well-jointed oolite, with some crinoid ossicles and rare well-preserved calices.

Based on the GSI mapping, 3 no. faults intercept the Site. The main fault trends northwest-southeast along the eastern part of the Site which is the approximate alignment of the River Suir channel.

Two faults are mapped perpendicularly to this main fault in the northern portion of the Site, 1 no. on the western side that is mapped predominantly in the north of the Site, whilst the fault on the eastern side seems to be juxtaposed north by the northwest-southeast orientated fault and is only mapped in the very northeasterly corner of the Site.

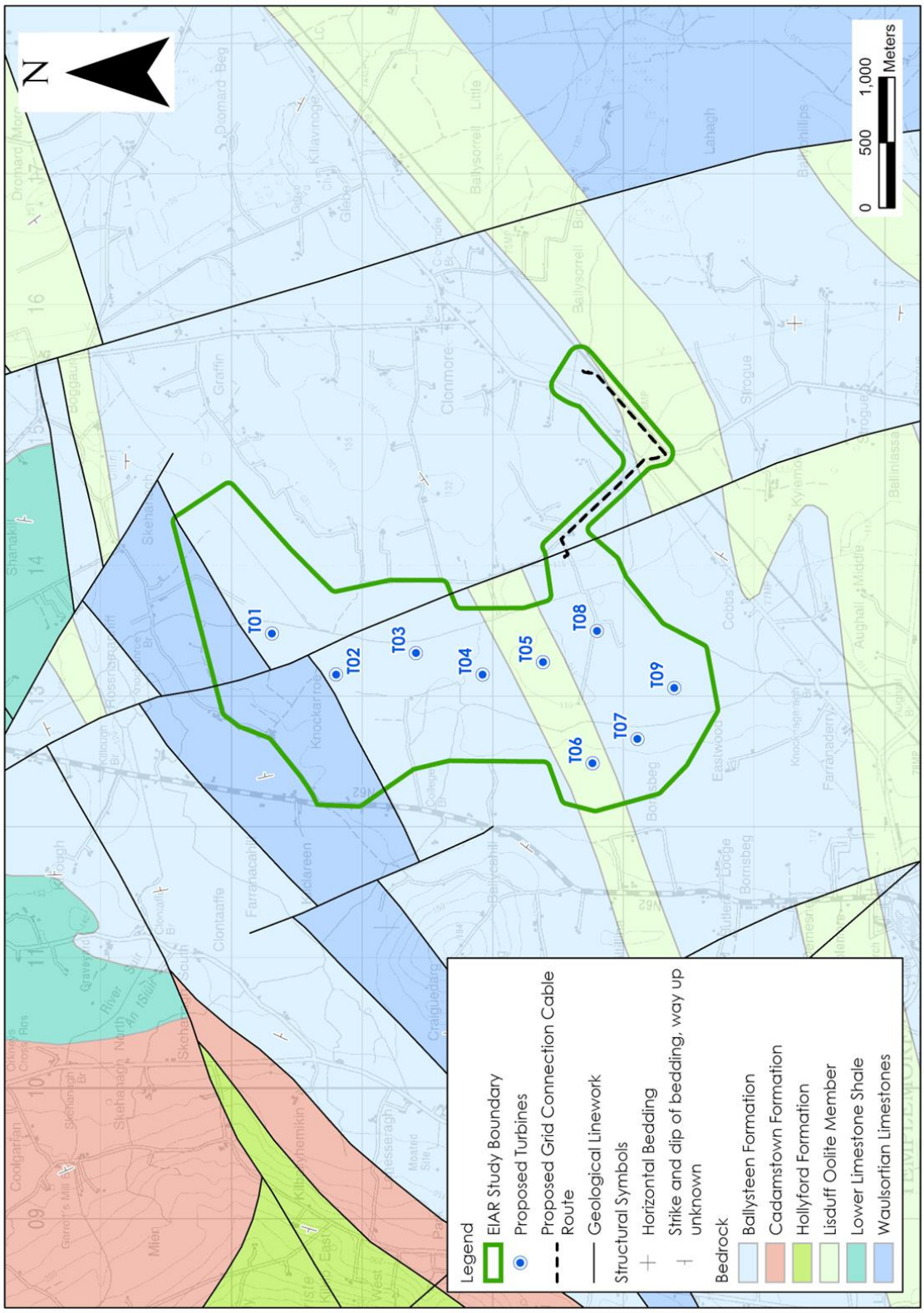
The Waulsortian Limestones and Lisduff Oolite member are pure limestones which are potentially prone to dissolution weathering (i.e. karstification). There are no mapped GSI mapped karst features in the vicinity of the Site.

8.3.4.1.1 *Proposed Grid Connection*

The Ballysteen Formation and Lisduff Oolite Member are mapped along the Grid Connection underground cabling route while the eastern mapped fault described in the previous section also intercepts the Grid Connection underground cabling route. There are no GSI mapped karst features in the vicinity of the Grid Connection (underground cabling route, 110kV substation and end masts) location.

A GSI bedrock geology map for the Site is shown as **Figure 8-2.**

Figure 8-2 Bedrock Geology Map



8.3.5 Site Investigations

Soil probing (143 no.) was undertaken along the Site infrastructure to investigate the extent of the peat as mapped by the GSI.

Peat soils were recorded at only 36no. of the 143 no. soil probe locations carried out within the Site.

Peat depths ranged from 0 to 0.8m with an average of approximately 0.37m. Over 80 percent of peat depth probes recorded peat depths of or less than 0.4m. Most of the "peat" encountered was organic/peaty topsoil.

With regard the Proposed Wind Farm infrastructure locations, peat up 0.8m deep was found along the proposed access road to turbine T9 including at the turbine location itself where 0.7m of peat was encountered.

Shallow peat of up to 0.2m was found along the proposed access roads to turbine locations T6 and T7, but not at the turbine locations themselves. All other probes carried out at the proposed infrastructure locations encountered mineral soil.

Of the 23 no. soil probes carried out along the Grid Connection and end mats, only 7 no. encountered shallow peat/peaty topsoil up to depths of between 0.2 and 0.3m.

A peat depth distribution plot for the Site is shown below at **Figure 8-3** below. Summary peat depths are shown on the site investigation map for the Site (**Figure 8-4).**

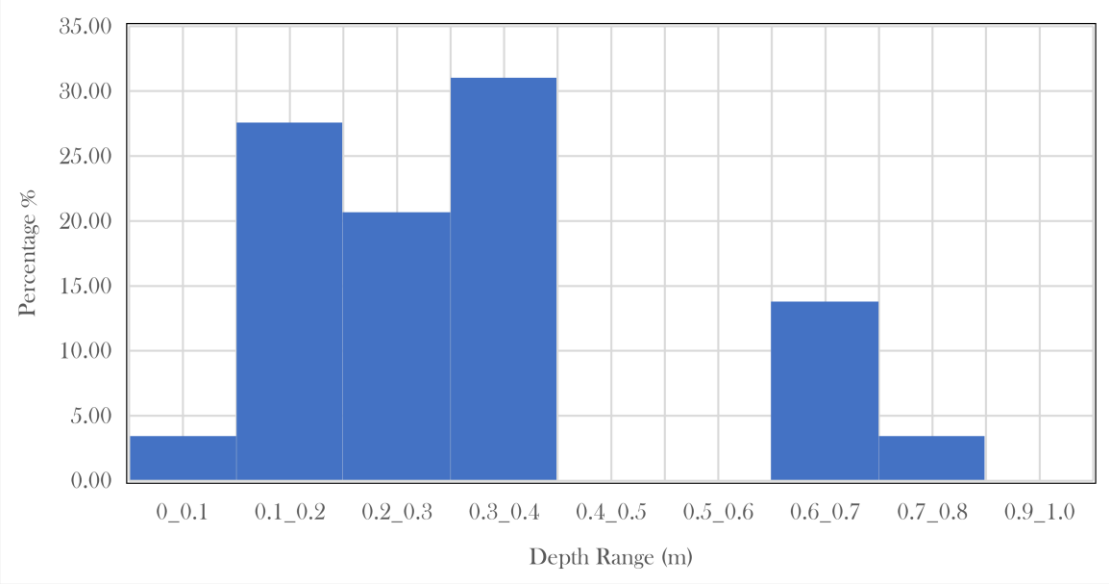
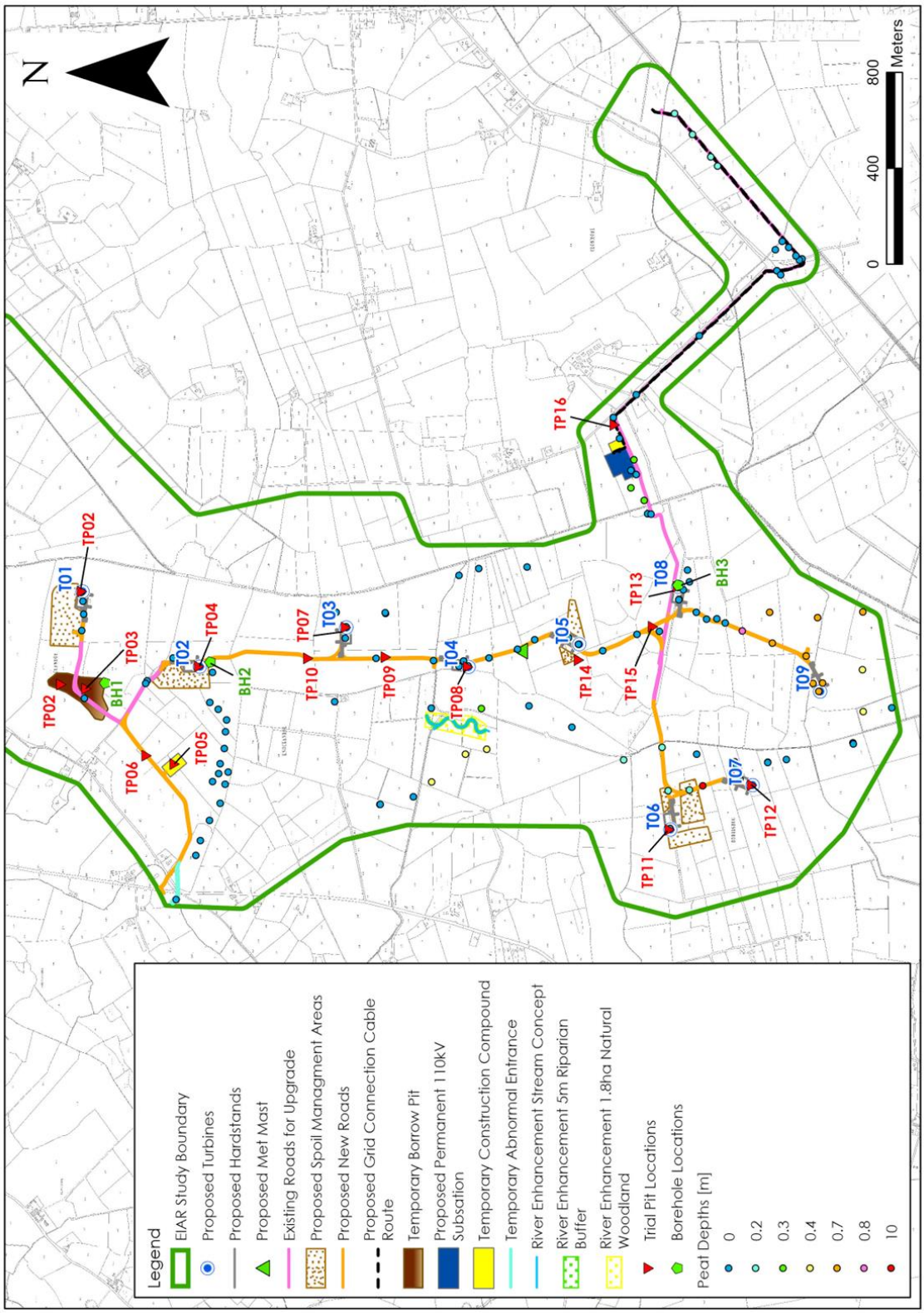


Figure 8-3 Peat Depth Distribution Plot

Figure 8-4 Site Investigation Map



A trial pit investigation was carried out at the Site by HES in July 2023. The ground investigation comprised 16 no. trial pits carried out on 3rd and 4th July 2023 (refer to **Figure 8-4** for trial pit locations).

The trial pits were carried out at the proposed turbine locations (excluding T9 due to forestry prohibiting access), borrow pit area, substation, temporary construction compound and at 4 no. various locations along Proposed Wind Farm access roads. The trial pit geological logs are attached as **Appendix 8-1**.

During the trial pitting, relatively shallow bedrock was proven at proposed turbine locations T4 (2.3m), T5 (1.4m), T6 (1.1m) and T7 (1.8m), as well as at the borrow pit (0.6 – 0.9m). Trial pitting did not encounter bedrock at turbine locations T1, T2, T3 and T8 due to deep alluvial deposits.

Follow up investigation drilling (constructed as monitoring wells) was carried out by Peterson Drilling Services Ltd on 10th & 11th July 2023. Boreholes (3 no. in total) were drilled at the proposed borrow pit (BH01), turbine location T2 (BH02) and turbine location T8 (BH03). The drilling was carried out to investigate the full geological profile (overburden and bedrock) at the Site and in particular to determine the full depth of the alluvial deposits. The drilling geological logs are attached as **Appendix 8-2**, summary logs are shown in **Table 8-5** further below.

The site investigations encountered alluvial deposits (mainly SAND dominated with various amounts of gravel & silt) at the 6 no. turbine locations (T1, T2, T3, T4, T5 & T8) and limestone tills at turbine locations T6 and T7, the substation and construction compound.

The PSD analysis shows the SAND content in the alluvial deposits is between 50 and 90% with fines (silt) less than 10%. The till samples analysed had a relatively even proportion of SILT, SAND and GRAVEL. No CLAYS were identified in any of the alluvial soils or tills. The PSD analysis reports are attached as **Appendix 8-3.**

The depth of overburden encountered during the site investigations ranged from 0.2m to 8.8m. Overburden depths are greatest closet to the River Suir channel which flows down the eastern portion of the Site. BH02 (at T2) and BH03 (at T8) are approximately 0.3km and 0.35km west of the River Suir where the respective depths of alluvial deposits are 8.8m and 4.8m.

Overburden depths appear to become shallow with distance from River Suir channel, as seen at turbines T6 and T7 which are the furthest (westerly) turbines from the River Suir channel where the respective overburden depths are 1.1m and 1.8m. Also, the alluvial deposits do not extend westerly as far as turbines T6 and T7.

Overburden depths (limestone tills) are shallowest on the northwest of the Site where only 0.2m was recorded at the temporary construction compound and 0.6 – 0.9m at the proposed borrow pit area.

Due to forestry coverage and lack of access at turbine T9, hand soil augering was only possible at this location which typically encountered dry fibrous peat with rootlets and plant remains above a darker brown layer of very decomposed peat. The peat was underlain by light grey, very fine-grained sandy SILT. The maximum depth of peat recorded at T9 was 0.7m.

Shown on **Table 8-4** below is a summary of the mineral subsoil lithology at the Proposed Project locations. The location of the investigation points and all peat depth data are shown on **Figure 8-4.**

Table 8-4: Summary of Mineral Subsoil Lithology at Proposed Project Locations

Infrastructure Location	Investigation I.D.	Depth to Bedrock (m)	Summary of Primary Mineral Subsoil Lithology
Proposed Wind Farm Infrastructure			
T1	TP01	Not met (>2.1m)*	Brown silty gravelly SAND with cobbles (non-cohesive alluvial deposits) Large groundwater inflows @ 2m from the sand and gravel
T2	TP04 & BH2	8.8	PEAT and CLAY (marl) over brown slightly silty gravelly SAND with cobbles (non-cohesive alluvial deposits) Large groundwater inflows at 2.4m from the sand & gravel
T3	TP07	Not met (>2.7m)*	Grey silty gravelly SAND with silt layers (sand is non-cohesive and flowing) Moderate groundwater inflows from sand layers below 2mbgl
T4	TP08	2.3	Firm brown silty gravelly SAND (cohesive) above Very firm purple CLAY. Refusal on competent limestone bedrock. Small groundwater inflows from base of sand layer
T5	TP14	1.4	Brown gravelly silty SAND, Refusal on competent limestone bedrock Notes: Trial pit done approximately 30m from Turbine T5 (not accessible due to silage)
T6	TP11	1.1	Very firm grey slightly sandy SILT Refusal on slightly weathered limestone bedrock
T7	TP12	1.8	SAND over very firm brown sandy gravelly CLAY (Boulder Clay) Refusal on boulders / bedrock presumed
T8	TP13 & BH03	4.8	Gravelly silty SAND (fine sand) with cobbles and boulders on strong/competent limestone bedrock
T9	GC01 & GC02	Unknown (soil probe only)	PEAT underlain by light grey, very fine-grained sandy SILT.
Construction Compound	TP05	0.2	Topsoil / Thin Subsoils on competent limestone rock

Borrow Pit	TP03, TP02 & BH01	0.6 – 0.9	Firm brown slightly gravelly sandy SILT/CLAY on weathered limestone bedrock
Access Road (at Construction Compound)	TP06	Not met (>0.5m)	Firm light brown SILT/CLAY
Access Road (T2 to T3)	TP10	Not met (>0.6m)	Firm brown SILT/CLAY
Access Road (T3 to T4)	TP09	Not met (>0.7m)	Firm brown SILT/CLAY
Access Road (T5 to T8)	TP15	Not met (>0.8m)	Firm grey CLAY
Proposed Grid Connection Infrastructure			
Infrastructure Location	Investigation I.D.	Depth to Bedrock (m)	Summary of Primary Mineral Subsoil Lithology
Substation & Temp. Cons. compound	TP16	Not met (>1.2)	Firm sandy, gravelly SILT/CLAY with cobbles and boulders Notes: Trial pit done approximately 100m east of substation (not accessible due to silage)
UG cabling & End Masts	23 no. SPs	n/a	Peaty soils (0.2 - 0.3m) over SILT/CLAY

**Note: Drilling in the alluvial deposits on the north of the Site (BH02 at turbine T2) suggest that bedrock is approximately 9mbgl (assumed depth for design purposes at turbines T1 and T3).*

Limestone bedrock was encountered in the 3 no. boreholes and at all 7 no. trial pits that met bedrock. Dark grey limestone was reported in BH2 and BH3 which is consistent with Ballysteen Formation mapped geology description. Light grey limestone was noted in BH1 which is consistent with Waulsortian Limestones mapped geology description.

The light grey limestone at BH1 was highly weathered at the top of rock, becoming very strong and then below 5mbgl clay filled fractures were frequent. This lithology is consistent with karstified limestone.

The bedrock geology was logged in detail during the drilling of the 3 no. monitoring wells and is summarised below in

Table 8-5. The locations of these borehole are shown in **Figure 8-4**.

Table 8-5: Summary of Drilling Investigations

Borehole ID	Total Depth (mbgl)	Summary of Geology
BH1 (Borrow Pit)	15	0 – 0.4: Firm brown TOPSOIL 0.4 -1.0: Weak highly weathered grey LIMESTONE 1.0 – 5.0: Very strong light grey LIMESTONE rare fractures 5.0 – 15.0: Medium strong to Strong grey LIMESTONE with frequent clay filled fractures
BH2 (Turbine T2)	24.5	0 – 0.3: Firm brown silty TOPSOIL 0.3 -0.7: Firm brown silty gravelly CLAY [BOULDER CLAY] 0.7 – 1.5: Soft dark brown PEAT 1.5 – 5.3: Loose grey gravelly SAND 5.3 – 8.8: Firm grey very sandy gravelly CLAY 8.8 -24.5: Strong dark grey LIMESTONE rare fractures
BH3 (Turbine T8)	12	0 – 0.3: Firm brown silty TOPSOIL 0.3 - 4.8: Soft to firm grey sandy silty CLAY becoming gravelly 4.8 – 12.0: Medium strong to Strong dark grey LIMESTONE occasional fractures

8.3.6 Geological Resource Importance

Based on NRA (2008) criteria in **Table 8-1**, bedrock underlying the Site can be classified as "Medium" importance. The bedrock could be used on a "sub-economic" local scale for construction purposes.

The alluvial subsoils at the Site can be classified as "Medium" importance. The alluvial subsoils could be used on a "sub-economic" local scale for construction purposes.

The limestone tills and localised shallow peat deposits/peaty topsoil at the Site could be classified as "Low" importance. The peat is not designated in this area and is significantly degraded due to the agricultural land improvement.

Refer to

Table 8-1 for definition of these criteria.

8.3.7 Geological Heritage and Designated Sites

There are no recorded Geological Heritage sites, mineral deposit sites or mining sites (current or historic) within 5km of the Site. A large, active limestone quarry called Lisduff Quarry (Site Code: LS019) is

located approximately 5.7km east from the Site. This is an important representative site with extensive exposures of Ballysteen Limestone.

Approximately 6.2km west from the Site is a mountain-top plateau with near-vertical cliffs called Devilsbit (Site Code: TY026). A geological heritage site called Borrisnoe and Cloncannon (Site Code: TY016) comprises a roadside quarry and farm/forestry track situated approximately 7.2km west from the Site. The Nore Valley Bog (Site Code: TY053) is located approximately 7.5km north from the Site and consists of an expansive area of raised bog.

Within the Republic of Ireland designated sites include Natural Heritage Areas (NHAs), Proposed Natural Heritage Areas (pNHAs), Special Areas of Conservation (SACs), candidate Special Areas of Conservation (cSAC) and Special Protection Areas (SPAs). A designated site map for the area is shown as **Figure 8-5.**

The Site is not located within any designated conservation site. The nearest designated site is the Templemore Wood pNHA (Site Code: 000942) which is located directly north of Templemore town, approximately 2km southwest of the Site boundary.

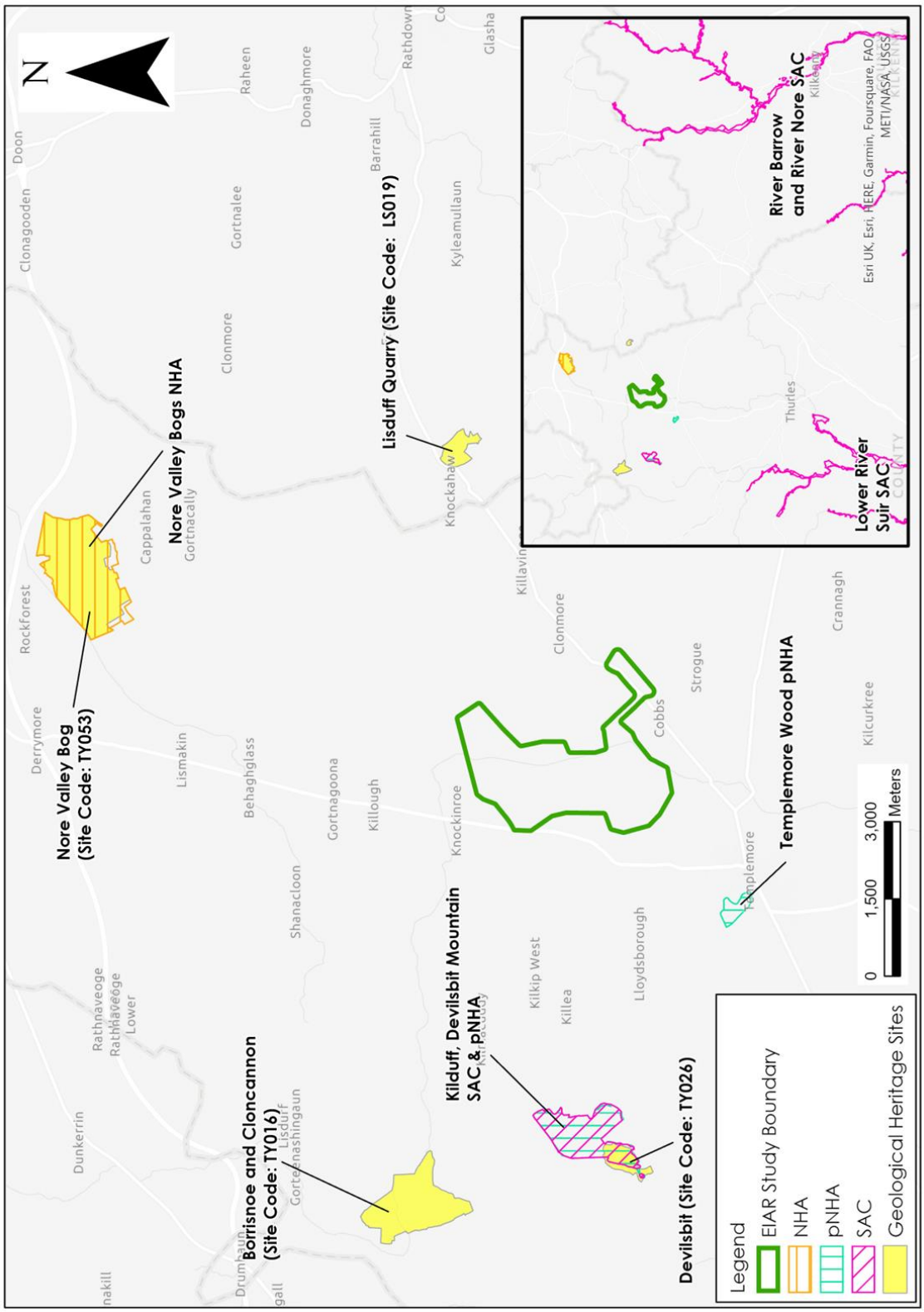
The Kilduff, Devilsbit Mountain pNHA and SAC (Site Code: 000934) is located approximately 5.3km west from the Site.

Designated sites that are hydrologically connected to the Site include the Lower River Suir SAC (Site Code: 002137) situated ~22km to the south and downstream of the Project site along the Suir River channel.

Further downstream the River Suir discharges into the River Barrow and River Nore SAC (Site Code: 002162) >100km downstream of the Proposed Project site. Hydrologically connected Designated Sites downstream of the Proposed Project are assessed in Chapter 9 (Hydrology/hydrogeology).

The locations of nearby Geological Heritage sites and Designated Sites and are shown on **Figure 8-5.**

Figure 8-5 Geological Heritage Sites and Designated Sites



8.3.8 Soil Contamination

There are no known areas of soil contamination on the Site. During the site walkovers or intrusive investigations, no areas of contamination concern were identified.

According to the EPA online mapping (http://gis.epa.ie/Envision), there are no licensed waste facilities on or within the immediate environs of the site of the Proposed Project. The closest IPC licenced facility is the Galmoy Mines site in Co. Laois which is located approximately 13.8km east of the Proposed Project site.

There are no historic mines at or in the immediate vicinity of the Site that could potentially have contaminated tailings.

8.3.9 Geohazards

The GSI Landslide database (www.gsi.ie) does not record any historic landslides in the vicinity of the Site or in the surrounding lands.

The GSI Landslide Susceptibility Map (www.gsi.ie) classifies the probability of a landslide occurring at a given location. The probability of a landslide occurring at the Site is mapped as being **Low**.

Due to the localised and very shallow nature of the peat, along with flat topography, the risk of peat instability or slide is very low.

8.4 Characteristics of the Proposed Project

8.4.1 Proposed Wind Farm

The Site construction will involve removal of soils, subsoils and bedrock in places, for access roads, underground cabling, turbine hardstanding areas, turbine and met mast foundations, construction compound and drainage works. Rock for construction purposes will be mainly sourced from an on-site borrow pit, with some material sourced from nearby commercial quarries. The estimated available rock volume is 70,000m^3 in the borrow pit.

Approximately 90,000m^3 of material will be required for the Proposed Wind Farm footprint with an estimated 70,000m^3 to be provided by the onsite borrow pit and the remaining 20,000m^3 to be imported from licenced quarries. There are 15 licenced quarries within 20km of the Site. Please see **Figure 4-20** for the location of these quarries.

The ground level at the borrow pit will be reduced from a maximum existing level of approximately 118.5m OD down to the proposed floor level of 112.5m OD.

Generally, for constructing any structure or platform foundation, such as a turbine base, hardstand or substation, removing all soft material is required to a depth where a suitable bearing material is encountered. Rock breaking maybe required at some of the turbines and hard-standing locations to create the reduced foundation level and the levelling required for construction. The material excavated is required to be properly managed and stored and should be re-used in other elements of the Proposed Wind Farm.

During turbine construction, soils and subsoils will be permanently excavated to the substrate to make room for the concrete foundation and a small working area surrounding the foundation footprint. Breaking and excavation of bedrock may be required where it is encountered at shallow depths to achieve the reduced foundation level and level surface required by design. Turbine foundations in the range of 25m in diameter are proposed.

The turbine foundations will either be gravity design or piled foundation depending on more detailed site investigations. The presence of deep alluvium deposits may require piled foundations at T1, T2, T3 and T8.

Gravity foundations depths are expected to be between 3m and 5m deep, depending on ground conditions at each turbine location. For the piled turbine foundations, a typical piling type and configuration could be up to 20 no. 900mm rotary bored piles down to suitable weight bearing substrate such as bedrock. The turbine crane hardstands will require to be founded on competent material underlying the topsoil layer.

The total volume of spoil (soil and subsoil superficial deposits) requiring placement/reinstatement within dedicated spoil placement areas within the Site is estimated at 121,600m^3 (refer to **Table 8-6** below).

A contingency factor of 10% has been applied and is included to the excavated spoil volumes above to allow for expected increase in volume upon excavation and to allow for a variation in ground conditions across the Site. The excess material will be placed in the borrow pit with remaining spoil deposited in dedicated Spoil Management Areas near T01, T02, T05 and T06 and in roadside berms in areas outside the modelled flood zone.

The proposed enhancement of a portion of the Eastwood River within the Site will involve the restoration of a previously deepened and straightened channel (currently approx. 240m in length) to a proposed length of approx. 300m. The enhancement involves creating a more meandering channel with pools and riffles. Material excavated from the proposed channel alignment will be used backfill sections of the straightened channel and any surplus will go to the Spoil Management Areas or borrow pit. The off-Site

turbine delivery route accommodation works are localised and relatively minor and will generate no spoil for storage.

Table 8-6: Estimated Spoil Excavation Volumes generated by the Proposed Wind Farm

Development Component	Spoil Volume(m3) (approx.)
9 no. Turbines, Hardstanding Areas and Cranepads	55,000
Access Roads	33,000
Met Mast and Hardstanding Area	373
Temporary Construction Compound	495
River Restoration	4,500
Borrow pit overburden	17,200
Total Spoil to be managed (m3) (including 10% contingency)	**121,600**

8.4.2 Proposed Grid Connection

The trench, within which the proposed underground cabling will be placed, will be typically 0.6m wide by 1.3m deep. The trench will be located predominately within the carriageway of public roads and grassland. Stone volumes required for the construction of the Proposed Grid Connection will be sourced off site from nearby licenced quarries. The majority of spoil generated during trench excavation will be removed and stored at the dedicated Spoil Management Areas within the Site. The trench will be backfilled and reinstated to the required specifications and finished as appropriate to the satisfaction of the local authority in the case of the public road section and new gravel track in the case of private lands.

The footprint of the proposed on-site 110kV substation compound measures approximately 11,605m^2 in area and will include 2 no. control buildings and the electrical substation components necessary to consolidate the electrical energy generated by each wind turbine. The proposed temporary construction compound measures 2,539m.^{2}

The foundations for the proposed end masts breaking the existing overhead line will have a total footprint area of approximately 77.8m$^{2.}$

The spoil volume requiring management for the Proposed Grid Connection infrastructure (see **Table 8-7** below) will be managed within the Site. However, some of the spoil may go to an appropriate licenced facility as required. This is dependent on the road makeup at locations along the underground electrical cabling route.

Table 8-7: Estimated Spoil Excavation Volumes for the Grid Connection

Development Component	Spoil Volume(m3) (approx.)
Permanent 110kV Substation and temporary construction compound	13,500
Grid Connection cabling Route and 2 no. end masts	3,600
Total Spoil to be managed m^3 (including 10% contingency factor)	**18,810**

8.5 Likely Significant Effects and Associated Mitigation Measures

8.5.1 Do Nothing Scenario

If the Proposed Project were not to proceed, the existing land use practices including agricultural activities and small-scale private forestry will continue at the Site. Land drainage carried out in areas of the Site will continue to function and may be extended in some areas.

If the Proposed Project were not to proceed, the opportunity to capture part of Tipperary's valuable renewable energy resource would be lost, as would the opportunity to contribute to meeting Government and EU targets for the production and consumption of electricity from renewable resources and the reduction of greenhouse gas emissions.

If the Proposed Project were not to proceed, the opportunity to retore a segment of the Eastwood River by improving channel stability, instream habitat and establishing a natural wooded riparian buffer would be lost. Please see Appendix 6-4 Biodiversity Management and Enhancement Plan for details.

8.5.2 Construction Phase - Likely Significant Effects and Mitigation Measures

The likely impacts of the Proposed Project, including construction works of the Proposed Wind Farm and the Proposed Grid Connection, and mitigation measures that will be put in place to eliminate or reduce them are shown below. These relate to the construction stage. It should be noted that the main potential impacts on the soils and geology environment will occur during the construction stage.

8.5.2.1 Effects on Land and Land use

Proposed Wind Farm

The loss of commercial forestry amounts to 4.22ha and the permanent loss of agricultural land amounts to 7.3ha.

Proposed Grid Connection

The footprint of the proposed on-site 110kV substation compound measures approximately 11,605m^2 while its associated temporary construction compound will measure approximately 2,539m^2 in area. The end masts cover a total of 77.80m$^{2.}$ In addition to this approximately 1.2km of new access road through third party land is required.

The Proposed Grid Connection will result in the loss of approximately 1.7ha of agricultural land. The remaining Grid Connection infrastructure comprises approximately 870m of the underground grid connection cable route which runs along existing roads.

There will be no effects on the lands adjoining the Site. Agriculture, forestry and public road transport routes will continue during the construction of both the Proposed Wind Farm and Proposed Grid Connection.

Pathway: Construction Land take

Receptor: Land and Landuse (i.e. the land upon which the Proposed Project will occur)

Potential Pre-mitigation Effect: Negative, moderate, direct, likely, long term effect on land and landuse at the Wind Farm site.

Negative, slight, direct, likely, long term effect on land and landuse along the Grid Connection.

Impact Assessment / Mitigation Measures
The loss of agricultural and forestry land resulting from the Proposed Project (8.47ha footprint in total) on a local or regional scale is minimal and therefore the effects of actual agricultural land loss is imperceptible.

No mitigation is proposed with regard agricultural or forestry loss of land as it is an accepted part of the Proposed Project.

The total amount to be felled (4.22ha) accounts for only approximately 9.6% of the existing forestry coverage at the Site which is approximately 43.8ha.

The total loss of agricultural land accounts for only approximately 1.16% of the landholding coverage at the Wind Farm site and 0.26% along the Grid Connection.

Residual Impact: Due to the small footprint of the Proposed Project on a local scale the residual effect is considered negative, direct, slight to moderate, likely, long term on land and landuse.

Significance of Effects: For the reasons outlined above, no significant effects on land or landuse will occur at the Proposed Project site.

8.5.2.2 Soil and Subsoil Excavation

Proposed Wind Farm

Excavation of mineral soil/subsoil and bedrock will be required for the installation of foundations for the access roads, turbine hardstands and foundations, for river restoration, temporary compound, met mast, and cable trenching within the Site. Minor excavations will take place at turbine delivery route/site entrance works. These works will result in temporary disturbance or permanent removal of soil, subsoil and bedrock at various excavation locations. Minor haul route works will not impact on land, soils and geology.

Proposed Grid Connection

Excavation of mineral soil/subsoil and bedrock will be required for the Proposed Grid Connection on-site 110kV substation and temporary construction compound, underground electrical cabling route and end masts within the Site.

The soil/subsoil can be classified as of “Low - Medium” importance. The bedrock, where encountered, can also be classified as of “Medium” importance.

Pathway: Extraction/excavation.

Receptor: Soil and subsoil.

Pre-Mitigation Potential Effect: Negative, moderate, direct, likely, permanent effect on soil, subsoil and bedrock due to relocation within the proposed Site.

Negative, slight, direct, likely, permanent effect on soil, subsoil and bedrock along the Grid Connection.

Proposed Mitigation Measures by Design:

- The soils and subsoil which will be removed during the construction of turbine hardstands will be localised to the turbine locations. The soil/subsoil will be placed/spread locally alongside the excavations or stored within the spoil management areas;
- Excavated soils/subsoils shall be excavated and stored separately to topsoil; this will prevent mixing of materials and facilitate reuse afterwards;
- All materials which require storage will be stockpiled at low angles (< 5-10°) to ensure their stability and secured using silt fencing where necessary. This will help to mitigate erosion and unnecessary additions of suspended solids to the drainage system;
- Spoil will be deposited, in layers of 0.50m and will not exceed a total thickness of 1m;
- No turbines or related infrastructure will be constructed in any designated sites such as NHAs or SACs;
- Soil/subsoil excavated along the underground electrical cabling route, will only be stored in low mounds (~0.5m high) directly adjacent to the excavated trench, and will be stored for no more than 24 hours before being backfilled where possible. The soil/subsoil will be covered in the event of heavy rainfall which would suspend further construction works along the underground electrical cabling route. Only tar from the underground electrical cabling route works will be disposed at an offsite licenced facility.

Residual Effect Assessment: The granular soil and peat at the site can be classified as of "Low - Medium" importance and the bedrock of "Medium" importance.

The overall Site area is extensive (650ha) while the Proposed Project footprint (8.47ha) is approximately 1.3% of the overall Site area. The negative effect is the disturbance and relocation of c. 140,410m^3 of soil and subsoil (Proposed Wind Farm and Proposed Grid Connection spoil volumes combined), and 70,000m^3 of bedrock during construction. The design measures incorporated into the Proposed Project as described above combined with the 'low - medium' importance of the deposits means that the residual effect will be negative, slight to moderate, direct, likely, permanent effect on soil, subsoils and bedrock due to disturbance and relocation within the Site.

Significance of Effects: For the reasons outlined above, no significant effects on peat and subsoils will occur.

8.5.2.3 Contamination of Soil by Leakages and Spillages

Proposed Wind Farm

Accidental spillage during refuelling of construction plant with petroleum hydrocarbons is a pollution risk. The accumulation of small spills of fuels and lubricants during routine plant use can also be a significant pollution risk. Hydrocarbon has a high toxicity to humans, and all flora and fauna, including fish, and is persistent in the environment. Large spills or leaks have the potential to result in significant effects (i.e. contamination of soil, subsoils and pollution of the underlying aquifer) on the geological and water environment, depending on where a spill may occur within the Site.

Proposed Grid Connection

The potential for contamination of soil by leakages and spillages is the same for the Proposed Grid Connection as that outlined for the Proposed Wind Farm.

Pathway: Soil and subsoil and underlying bedrock pore space.

Receptor: Soil and subsoil, bedrock.

Pre-Mitigation Potential Effect: Negative, slight, direct, short-term, unlikely effect on soil, subsoils and bedrock at the Site.

Proposed Mitigation Measures:

- Where possible maintenance of construction vehicles or plant will take place off-site. This applies to the construction activities for both the Proposed Wind Farm and the Proposed Grid Connection. Minimal maintenance of construction vehicles or plant will take place on-site;
- On-site re-fuelling will be undertaken using a double skinned bowser with spill kits on the ready for any minor accidental leakages or spillages;
- Fuels stored on Site will be minimised but will be in designated bunded locations;
- The electrical control building at the onsite 110kV substation will be bunded appropriately to the volume of oils likely to be stored, and to prevent leakage of any associated chemicals and to groundwater or surface water. The bunded area will be fitted with a storm drainage system and an appropriate oil interceptor;
- All waste tar and chip material arising from the chipping and resurfacing of the roads during construction of the underground electrical cabling route will be removed off-site and taken to an appropriately licenced facility;
- The plant used during construction will be regularly inspected for leaks and fitness for purpose; and,
- An emergency plan for the construction phase to deal with accidental spillages will be contained within the Construction Environmental Management Plan (CEMP) Appendix 4-3 of this EIAR. Spill kits will be available to deal with accidental spillage in and outside of re-fuelling areas.

Residual Effect Assessment: The use and storage of hydrocarbons and small volumes of chemicals is a standard risk associated with all construction sites. Proven and effective measures to mitigate the risk of spills and leaks have been proposed above and will break the pathway between the potential source and the receptor. The residual effect will be negative, imperceptible, direct, short-term, unlikely effect on soil and subsoils and bedrock.

Significance of Effects: For the reasons outlined above, and with the implementation of the listed mitigation, no significant effects on soil, subsoils and bedrock will occur.

8.5.2.4 Erosion of Exposed Soil and Subsoils During Construction of Infrastructure

Proposed Wind Farm

Erosion of soil/subsoil by the pathways listed below, can have the effect of reducing the overall volume of soil/subsoil at the Site, with the potential for some eroded subsoils to reach watercourses, leading to water quality issues such as high turbidity. Erosion of soils/subsoils may occur at any works area where excavation is ongoing i.e. turbine foundations and hardstands, access roads, river restoration area, construction compound, met mast and felling areas within the Site.

Proposed Grid Connection

The potential for erosion of exposed soil and subsoils during construction of the Proposed Grid Connection infrastructure is the same as that outlined for the Wind Farm.

The main potential impacts associated with this aspect is to the water environment, and therefore this aspect is further assessed in detail in Chapter 9.

Pathway: Vehicle movement, surface water and wind action.

Receptor: Soil and subsoil.

Pre-Mitigation Potential Effect: Negative, imperceptible to slight, direct, permanent, likely effect on soil and subsoils by erosion and wind action at the Site.

Proposed Mitigation Measures:

- Soil/subsoil removed from the turbine locations and associated access roads will be used for landscaping or placed/spread locally alongside the excavation (no excavated material will be placed/spread inside the modelled fluvial flood zones).
- Site drainage systems will be installed to limit runoff impacts during the construction phase, see Chapter 9 for proposed drainage measures.
- In forestry areas (near T9) brash mats will be used to support vehicles on soft ground, reducing soil erosion and avoiding the formation of rutted areas, in which surface water ponding can occur. Brash mat renewal will take place when they become heavily used and worn. Provision will be made for brash mats along all off-road routes, to protect the soil from compaction and rutting.
- Soils removed from the cable trenching within the Site will be used to reinstate the trench where possible or removed to one of the designated spoil management areas or to an appropriately licenced facility as necessary. Soil, Subsoil removed from the Grid Connection groundworks will be removed and either used for Site reinstatement/landscaping works, placed in a spoil management area or taken to an appropriately licenced facility.

Residual Effect Assessment: Soils, subsoils and spoil can be eroded by vehicle movements, wind action and by water movement. To prevent this all excavation works and spoil storage will be carried out using best practice methods (section 2.3 of CEMP Appendix 4-3) and most spoil material will remain within the Site and reseeding and planting will be completed to bind landscaped soil and spoil together. Following implementation of these measures the residual effects will be negative, imperceptible, direct, permanent, likely effect on soil and subsoils by erosion and wind action at the Site.

Significance of Effects: For the reasons outlined above, no significant effects on soils, subsoils or bedrock will occur.

8.5.3 Operational Phase - Likely Significant Effects and Mitigation Measures

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

Proposed Wind Farm

- Some construction vehicles or plant may be necessary for maintenance of turbines which could result in minor accidental leaks or spills of fuel/oil;
- The transformers in each turbine are oil cooled. There is potential for spills / leaks of oils from this equipment resulting in contamination of soils and groundwater; and,
- In relation to 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.

Proposed Grid Connection

- The transformer in the substation are oil cooled. There is potential for spills / leaks of oils from this equipment resulting in contamination of soils and groundwater; and,
- In relation to 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.

None of these potential impacts will be significant, as they are of such small scale and also of an intermittent nature.

Pre-Mitigation Potential Effect

The small amount of granular material required to maintain access tracks during operation will place intermittent minor demand on local quarries, but the effect will be imperceptible.

Oil used in transformers (at the substation and within each turbine) and storage of oils in tanks at the substation could leak during the operational phase and impact on ground/soil and subsoils and groundwater or surface water quality.

Proposed Mitigation Measures

The substation transformer will be on a bunded concrete plinth capable of holding 110% of the stored oil volume. Turbine transformers are located within the turbines, so any leaks would be contained within the turbine. These mitigation measures are considered sufficient to eliminate potential risks to ground/peat/soils and subsoils, and groundwater and surface water quality.

Mitigation measures for land, soils and geology during the operational phase include the use of aggregate from authorised quarries for use in road and hardstand maintenance.

Significance of Effects: For the reasons outlined above, effects on land, soils and geology associated with the Operational Phase are imperceptible.

8.5.4 Decommissioning Phase - Likely Significant Effects and Mitigation Measures

The potential effects associated with decommissioning of the Proposed Project will be similar to those associated with construction but of reduced magnitude. The Proposed 110kV substation will not be decommissioned, as it will form part of the national electricity grid.

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

Other impacts such as possible soil contamination by fuel leaks will remain but will be of reduced magnitude. However, as noted in the Scottish Natural Heritage report (SNH) Research and 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. According to the SNH guidance, 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".*

Mitigation measures applied during decommissioning activities will be similar to those applied during construction phase as shown in Section 8.5.2 above. Please see Decommissioning Plan Appendix 4-4.

Some of the impacts will be avoided by leaving elements of the Proposed Project in place where appropriate. The turbine foundations will be rehabilitated by covering with local topsoil and subsoil in order to regenerate vegetation which will reduce runoff and sedimentation effects. Internal roads will remain as access roads for landowners. 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.

No significant effects on the land, soils and geological environment will occur during the decommissioning stage of the Proposed Project.

8.5.5 Assessment of Human Health Effects

Potential human health effects arise mainly through the potential for soil and ground contamination. A wind farm and associated grid connection is not a recognized source of pollution and so the potential for effects during the operational phase are imperceptible. Hydrocarbons will be used onsite during construction however the volumes will be small in the context of the scale of the project and will be handled and stored in accordance with best practice mitigation measures. The potential residual impacts associated with soil or ground contamination and subsequent health effects are imperceptible.

8.5.6 Cumulative and in-combination Effects

The potential for impact between the Proposed Project, and other relevant developments has been carried out with the purpose of identifying what influence the Proposed Project (Proposed Wind Farm and Proposed Grid Connection combined) will have on the surrounding environment when considered cumulatively and in combination with relevant existing permitted or proposed projects and plans in the vicinity of the Site, as set out in Chapter 2 of this EIAR. Please see Section 2.8 of Chapter 2 for cumulative assessment methodology.

8.5.6.1 Construction Phase

The nature of the construction works within the Proposed Project site mean that the effects on the land, soils and geology environment are restricted to the immediate areas of the construction works. The only cumulative effect of the Proposed Project with respect to the lands, soils and geology will be due to the potential removal and transport of material to a licensed waste facility, where required. The environmental effects of the placement of material within the licenced waste facility will have been previously assessed during the licensing process of this facility. There will be no further cumulative effects on the land, soils and geology environment during the construction phase of the Proposed Project.

8.5.6.2 Operational Phase

During the operational phase of the Proposed Project all aspects of the land, soils and geology environment will remain constant, with no alteration of any aspect of this environment. As a result, there will be no cumulative effects due to the Proposed Project.

8.5.6.3 Decommissioning Phase

During the decommissioning phase, there will be minimal disturbance of soil/subsoil. The underground electrical cabling ducts will be left in-situ (cables removed by re-opening the joint bays used for the installation of the cabling) and turbine foundations will not be removed but covered over with soil/subsoil. These works will be limited in scale and there is no potential for cumulative effects with other nearby developments.

8.5.7 Post Construction Monitoring

None required.