8. LAND SOILS AND GEOLOGY

8.1 Introduction

8.1.1 Background and Objectives

Hydro-Environmental Services (HES) was engaged by McCarthy Keville O'Sullivan (MKO) to carry out an assessment of the potential significant impacts of the Proposed Development on the land, soil and geological environment.

This report provides a baseline assessment of the environmental setting of the Proposed Development, as described in Chapter 4, in terms of land, soils and geology and discusses the potential likely significant effects and cumulative effects that the construction, operation and decommissioning of the Proposed Development will have. Where required, appropriate mitigation measures to avoid any identified significant effects to land, soils, geology and natural resources are recommended and the residual effects of the proposed project post-mitigation are assessed.

In this chapter we refer to the Wind Farm Site (15 no. turbines, access roads, onsite substation borrow pits, temporary construction compound, forestry felling and all associated works), and the Grid Connection Route (26km long running from the proposed wind farm site to Mullingar substation where upgrade works are proposed), and the Proposed Development study area. Other elements of the Project are referenced accordingly (i.e. replacement planting lands).

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 and Adam Keegan.

Michael Gill (BA, BAI, Dip Geol., MSc, MIEI) is an Environmental Engineer and Hydrogeologist with over 18 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 surface water drainage design and SUDs design and surface water/groundwater interactions. For example, Michael has worked on the EIS/EIAR for Coole WF, Oweninny WF, Cloncreen WF, and Yellow River WF, and over 100 other wind farm related projects across the country.

Adam Keegan (BSc, MSc) is a hydrogeologist with three years of experience in the environmental sector in Ireland. Adam has been involved in Environmental Impact Assessment Reports (EIARs) for numerous projects including wind farms, grid connections, quarries and small housing developments. Adam holds an MSc in Hydrogeology and Water Resource Management. Adam has worked on several wind farm EIAR projects on the land, soils and geological environment, including Croagh WF, Lyrenacarriga WF (SID), Cleanrath WF, Carrownagowan WF (SID), and Fossy WF.

8.1.3 Scoping and Consultation

The scope for this assessment has been informed by consultation with statutory consultees, bodies with environmental responsibility and other interested parties as summarised in Section 2.6 of Chapter 2 of the EIAR. Consultation responses relating to the land, soils and geological environment were received from Geological Survey Ireland, Office of Public Works, and the Department of Agriculture Food and the Marine.

8.1.4 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:

- S.I. No. 349 of 1989: European Communities (Environmental Impact Assessment) Regulations, and subsequent Amendments (S.I. No. 84 of 1995, S.I. No. 352 of 1998, S.I. No. 93 of 1999, S.I. No. 450 of 2000 and S.I. No. 538 of 2001), S.I. No. 30 of 2000, the Planning and Development Act, and S.I. 600 of 2001 Planning and Development Regulations and subsequent Amendments. These instruments implement EU Directive 85/373/EEC and subsequent amendments, on the assessment of the effects of certain public and private projects on the environment;
- Directives 2011/92/EU and 2014/52/EU on the assessment of the effects of certain public and private projects on the environment, including Circular Letter PL 1/2017: Implementation of Directive 2014/52/EU on the effects of certain public and private projects on the environment (EIA Directive);
- Planning and Development Act, 2000, as amended;
- S.I. No 296 of 2018: S.I. No. 296 of 2018: European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 which transposes the provisions of Directive 2014/52/EU into Irish law; and,
- The Heritage Act 1995, as amended.

8.1.5 Relevant Guidance

The land, soils and geology chapter of this EIAR was prepared having regard to guidance contained in the following documents:

- Environmental Protection Agency (2017): Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports;
- Environmental Protection Agency (2015): Draft - Advice Notes on Current Practice (in the preparation of Environmental Impact Statements;
- Environmental Protection Agency (2015): Draft – Revised Guidelines on the Information to be contained in Environmental Impact Statements;
- Environmental Protection Agency (2003): Advice Notes on Current Practice (in the Preparation of Environmental Impact Statements);
- Environmental Protection Agency (2002): Guidelines on the information to be contained in Environmental Impact Statements);
- 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 Union, 2017).

8.2 Assessment Methodology

8.2.1 Desk Study

A desk study of the study area was completed in advance of undertaking the walkover survey and site investigations. The 2020 desk study was used in conjunction with previous desk studies of the 13 no. original proposed turbines (2017). The desk study involved collecting all the relevant geological data for the 15 no. turbine Wind Farm and Grid Connection Route areas. This included consultation with the following:

- Environmental Protection Agency database (www.epa.ie);
- Geological Survey of Ireland - National Draft Bedrock Aquifer map;
- Geological Survey of Ireland - Groundwater Database (www.gsi.ie);
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 12 (Geology of Longford - Roscommon);
- Geological Survey of Ireland (GSI, 1999);
- Geological Survey of Ireland – 1:25,000 Field Mapping Sheets; and,
- General Soil Map of Ireland 2nd edition (www.epa.ie);

8.2.2 Baseline Monitoring and Site Investigations

Geological mapping and a detailed walkover survey within the Wind Farm Site was undertaken by HES on 13th to 14th December 2016, 02nd February, 08th March, and 23rd March 2017. Geotechnical ground investigations were undertaken by HES and AGEC[1], and these data sets were used to complete peat stability assessment which was undertaken by AGEC Ltd within the Wind Farm site.

Further site investigations including geotechnical ground investigations were carried out by HES on 23rd September 2020 within the T14 and T15 site area and by FTCO in September 2020. Additional site visits were also completed within the Wind Farm Site on 15th and 22nd October 2020 which included water level dips in piezometers/boreholes. In summary, site investigations to address the soil and geology section of the EIAR included the following:

Wind Farm Site

- A total of over 250 no. peat probe depths were carried out by AGEC Ltd and HES between December 2016 – August 2020 to determine the depth and geomorphology of the cutover peat at the Wind Farm Site, including 16 no. locations along the link road within the Wind Farm Site;
- 2 no. trial pits were completed at the site compound within the Wind Farm Site;
- 6 no. trial pits were completed at the borrow pit;
- 8 no. window sample holes were completed at turbine bases (at T1, T2, T3, T7, T8, T9, T11, T13), and 2 no. gouge cores were completed adjacent to T1 and T2 (WS100 and WS101) on 15th December 2016;
- 13 no. rotary core boreholes were drilled by Ground Investigations Ireland at turbine locations T1-T4, T6-T13 and at the proposed substation in July 2020.
- A geotechnical assessment of peat stability for the Wind Farm Site was completed by AGEC Ltd (June, 2017). This has been updated to include the proposed T14 and T15 (January 2021) by FTCO;
- Logging of lacustrine and subsoil exposures during site all visits; and,
- Mineral subsoils and peat were logged according to BS:5930 and Von Post Scale respectively.

[1] *AGEC Ltd were rebranded and became Fehily Timoney Company (FTCO) in 2019.*

Grid Connection Route

- A total of 80 no. peat probe depths were carried out by AGEC Ltd in 2017, along with 9 no. Russian cores by Apex Geophysics Ltd in 2019, to determine the depth and geomorphology of the blanket peat along certain sections of the Grid Connection Route;
- Shear vane tests were completed at 3 no. priority locations along the Grid Connection Route;
- A geophysical survey was carried out by APEX Geophysics Ltd along the Grid Connection Route from Coole to Multyfarnham, Co. Westmeath (15.6km section); and,
- A geophysical investigation report of peat and substrate depths along the Grid Connection Route was carried out by APEX Geophysics Ltd (Oct 2019);

The Wind Farm Site Peat Stability Assessment report (January 2021) prepared by FTCO is included as Appendix 8-1 of this EIAR. The Grid Connection Route Peat depth and Stability report prepared by AGEC Ltd is included as Appendix 4-4.

8.2.3 Impact Assessment Methodology

Using information from the desk study and data from the site investigations, an assessment of the importance of the soil and geological environment within the study area and Proposed Development 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	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.

Importance	Criteria	Typical Example
	moderate on a local scale.	Sub-economic extractable mineral Resource.
Low	Attribute has a low quality, significance or value on a local scale. Degree or extent of soil contamination is minor on a local scale. Volume of peat and/or soft organic soil underlying site is small on a local scale.	Large historical and/or recent site for construction and demolition wastes. Small historical and/or recent landfill site for construction and demolition wastes. Poorly drained and/or low fertility soils. Uneconomically extractable mineral Resource.

The guideline criteria (EPA, 2017) 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 (2017) 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	Low	A low likelihood of occurrence of the impact.
	Medium	A medium likelihood of occurrence of the impact.
	High	A high likelihood of occurrence of the impact.

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.

Impact Characteristics		Potential Hydrological Impacts
Quality	Significance	
Positive or Negative	Significant	Local or widespread time-dependent impacts on: › The extent or morphology of a cSAC / ecologically important area. › 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

8.3.1.1 Wind Farm Site

The Wind Farm Site is located approximately 2.4 km north of Coole village and 3.5 km south of the village of Finnea (distance from proposed Wind Farm Site boundary). The townlands in which the proposed Wind Farm Site is located are listed in Table 1-1 in Chapter 1 of this EIAR. Three separate, but adjacent, peat basins form the proposed Wind Farm Site, and these are all located to the east of the Inny River.

The majority of the Wind Farm Site (locations of T1-T4 and T6-T13) is situated on cut-over Peat, and the elevation of the site ranges between approximately 60m OD and 66m OD. Lough Bane, a proposed National Heritage Area (pNHA) is located immediately northeast of the proposed Wind Farm Site. The Wind Farm Site is also partially bound by the Inny River to the west, agricultural land to the south and east, and coniferous forestry and a peat bog to the north. The River Glore intersects the northern section of the Wind Farm Site as it flows from southeast to northwest.

Proposed turbine T14 is located towards the southwest of the Wind Farm Site. The topography within this area slopes northwest towards the southwestern bog of the Wind Farm Site, with elevations between 60-65 mOD. The proposed locations of turbine T14 and turbine T5 are situated in areas of coniferous forestry. T5 is located ~1.7km northeast of T14 at an elevation of ~60-65 mOD.

The proposed turbine T15 is situated within the townland of Carlanstown, ~1km southeast of the 3 no. bog basins. Topography slopes northeast from ~60-85 mOD towards the River Glore, which runs through the centre of the proposed turbine T15 location.

The total Wind Farm Site measures approximately 498 hectares. The footprint of the Proposed Development measures approximately 26.4 hectares, which represents only 5.3% of the primary site.

Grid Connection Route

The proposed Grid Connection Route passes along public roads between Monktown, Coole, and Irishtown, Mullingar. The Grid Connection Route begins at the onsite substation where it then enters the road boundary along the R396, ~ 3km northwest of Coole in the townland of Monktown and passes south along the L1826 to Multyfarnham along the western edge of Lough Derravaragh and adjacent to the River Inny. It then continues south along the N4, adjacent to the eastern side of Lough Owel and the River Gaine. It terminates at the 1100kV substation in Irishtown, Mullingar. The proposed grid connection route has a length of ~26 km.

The overall elevation along the Grid Connection Route ranges between approximately 60 to 120m OD (Ordnance Datum) with a gradual increase in elevation from the bog areas around Coole southwards towards Mullingar.

8.3.2 Peat/Soils and Subsoils

8.3.2.1 Wind Farm Site

Subsoils within the majority of the proposed Wind Farm Site are mapped as Cut over Raised Peat. The only exception is at T15, where subsoils are mapped as Till derived from Limestone to the southwest of the proposed turbine T15, with Cut over Raised peat mapped to the northeast.

The published soils maps (www.gsi.ie) show that Cutaway Peat (Cut) is mapped as the topsoil for the majority of the Wind Farm Site. Soils within the area near T15 are mapped as BminDW (well drained, basic mineral soil).

There is a small area of mapped sand and gravel deposits along the eastern edge of the central bog basin within the Wind Farm Site. On the western boundary of the Wind Farm Site, where it borders the Inny River, the topsoil is identified as Mineral alluvium (AlluvMIN). A subsoil map is shown as Figure 8-1.

The bog basins (3 no. basins: Northern Basin, Central Basin, and Southern Basin. Refer to Figures 9-4 to 9-5) within the Wind Farm Site were essentially formed in poorly drained topographical depressions within the north of the Midlands. Prior to the growth of the bog, the area would have comprised water-logged and shallow lakes, which since the end of the last Ice Age have become silted up, and closed over with vegetation, which initiated the formation of a series of raised peat basins.

Overall peat depths recorded during the peat probing investigation (HES & AGEC/FTCO 2016-2020) ranged from 0 to 7.8m with an average of 3.2m. Peat depths recorded during the drilling of the 13 no. rotary core boreholes at proposed turbine locations ranged from 2 to 12.5m. The rotary core borehole peat depth measurement of 12.5m occurred at T12. The upper value of 12.5m recorded at T12 appears to be a local anomaly as other peat depth data from within ~50/100m of T12 indicates peat depths of ~4.5 to 5.3m. Peat at the proposed Wind Farm Site is underlain by calcareous shell marl, and lacustrine

deposits of varying thickness. Average peat depths (number of data points = 10) recorded at the substation location is 2.0m.

Average peat depths within the T14 and T15 areas, from site investigations (gouge cores) undertaken by FTCO and HES are 1.0m and 1.5m respectively.

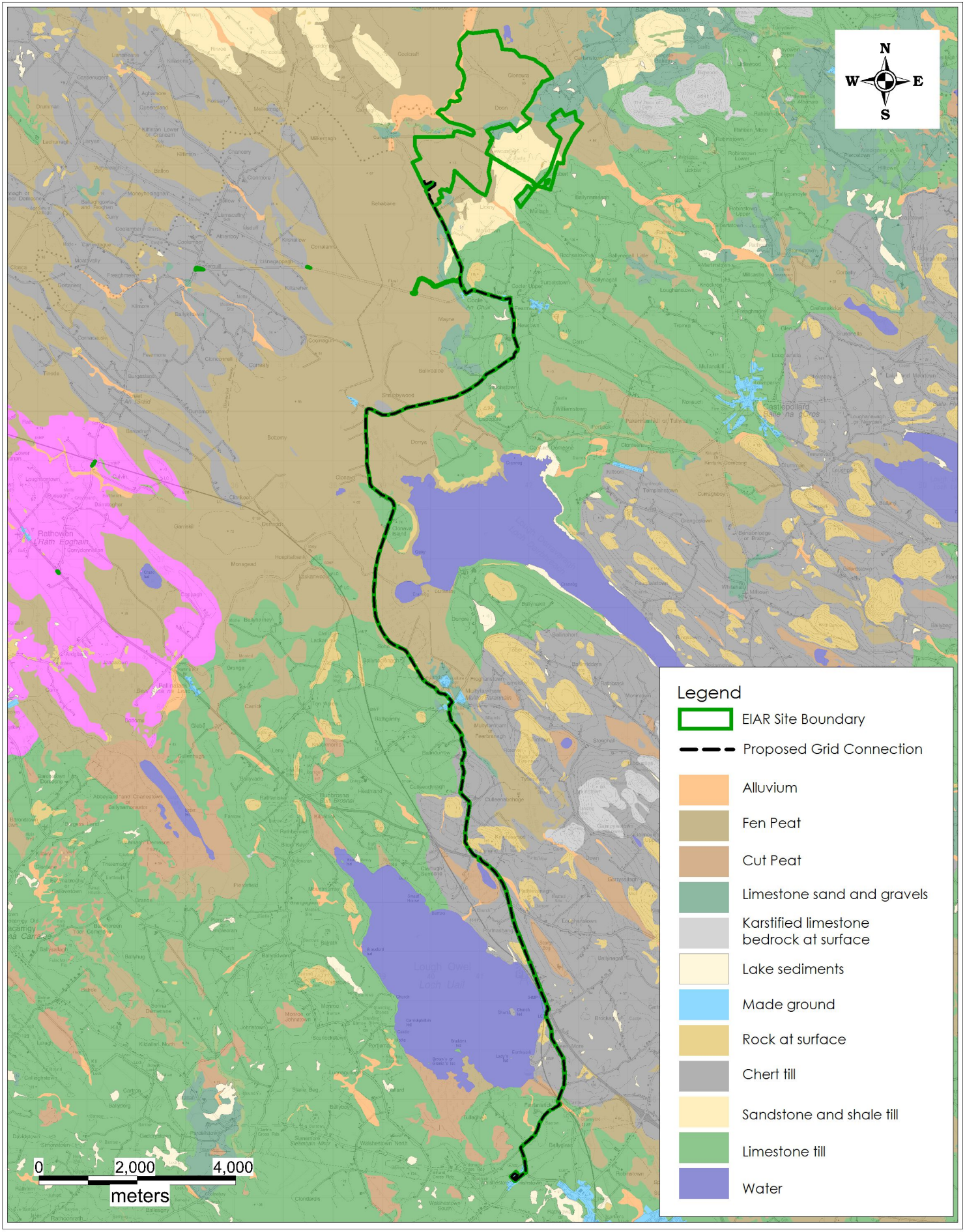
A site investigation location map is shown as Figure 8-2. This map shows the locations of trial pits, window sample holes, rotary boreholes and peat probes completed at the study area. Trial pit logs and window sample hole logs are attached in Appendix 8-2. A summary of ground conditions at the Wind Farm Site infrastructure locations is provided in Table 8-4, as well as further information from rotary core boreholes at a number of turbine locations and at the substation within Table 8-5. A graph of peat depth distributions at the wind farm site is included as Figure 8A.

The ground conditions at the Wind Farm Site (including the link road area) can be categorised into the following deposits:

- Peat – Typically described as brown/dark brown fibrous and amorphous peat. Peat thicknesses from peat probing, window sampling and drilling ranged from 0 to 12.5m. The average peat depths recorded at infrastructure locations across the Wind Farm Site was 3.9m. The peat depth recordings are shown in Figures 8-3 and 8-4.
- Calcareous Mud/Shell Marl – Soft cream coloured mud with local deposits of shell fragments. The thickness of the layer is variable across the site from 0.3 to 1.85m. In a number of locations (*i.e* WS100 & WS101 near T2), the bottom of the calcareous mud deposit was not determined.
- Lacustrine Clay – Locally grey to dark grey soft to firm clay. The marl is considered to be a lacustrine deposit. The thickness of the layer varies from 0.3 to 5.6m. In a number of locations the full extent of the lacustrine soil was not determined (*i.e* at T1, T2, T3 and T7). The lacustrine deposits appear to thicken towards the River Glore and Inny River.
- Glacial Granular Soils – Locally loose to dense wet grey sandy clayey silty gravel. This layer was locally encountered in a small number of the trial pits (BP-TP2-TP4 and -TP5 and TP1-C). The glacial granular soils are likely to have a mixed strength/density.
- Weathered Bedrock – Possible weathered bedrock was only encountered in trial pit TP2-C. Arisings from the trial pit comprised of large angular cobbles and a matrix of sandy silt and angular gravel.
- Limestone bedrock – Limestone bedrock was encountered during the rotary core boreholes drilled at 13 no. locations. The bedrock is described as generally medium strong to strong, dark grey, fine grained, thinly to thickly bedded Limestone.

The ground conditions at the borrow pit can be typically categorised into the following deposits:

- Topsoil – Typically described as sandy gravelly clay.
- Glacial Till – Consisted of orange to brown slightly gravelly Clay. Deposits ranged from 0.3m to 1.1m in thickness.
- Weathered Bedrock – Typically consisting of angular gravels, cobbles and boulders of weathered limestone in a clay matrix. Weathered bedrock was typically encountered between 0.2m and 1.3mbgl.
- Bedrock – Bedrock comprises of strong intact limestone at typically 1.5mbgl.



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Scale: 1:100,000	Project No: P1320-2
Drawn By: GD / Checked By: MG	Drawing No: P1320-2-0121-A4-801-00A

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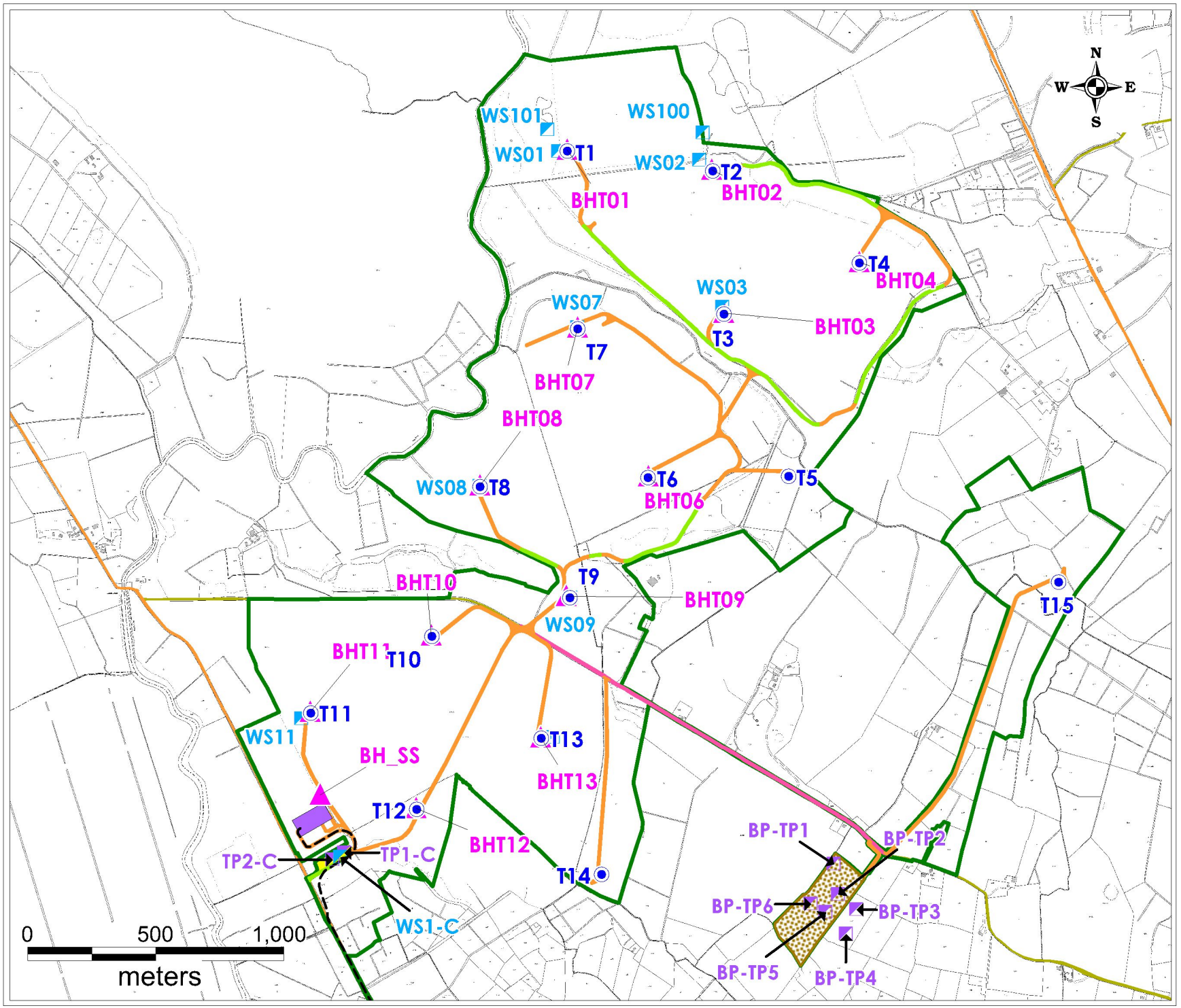

Legend

- EIAR Site Boundary
- Proposed Turbine Layout
- Proposed Grid Connection
- Proposed Borrow Pit
- Proposed Substation
- Proposed Construction Compound
- Internal Roads (Upgrades to Existing)
- Internal Roads (New)
- External Roads (Upgrades to Existing)
- Regional Road
- Window Sample Location
- Trial Pit Location
- Boreholes_2020 (GII)

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Title: Site Investigation Map

Client: MKO

Job: Coole WF, Co. West Meath

Project No: P1320-2

Figure No: 8-2

Sheet Size: A4

Drawing No: P1320-2-0121-A4-802-00A

Date: 05/01/2021

Scale: 1:20,000

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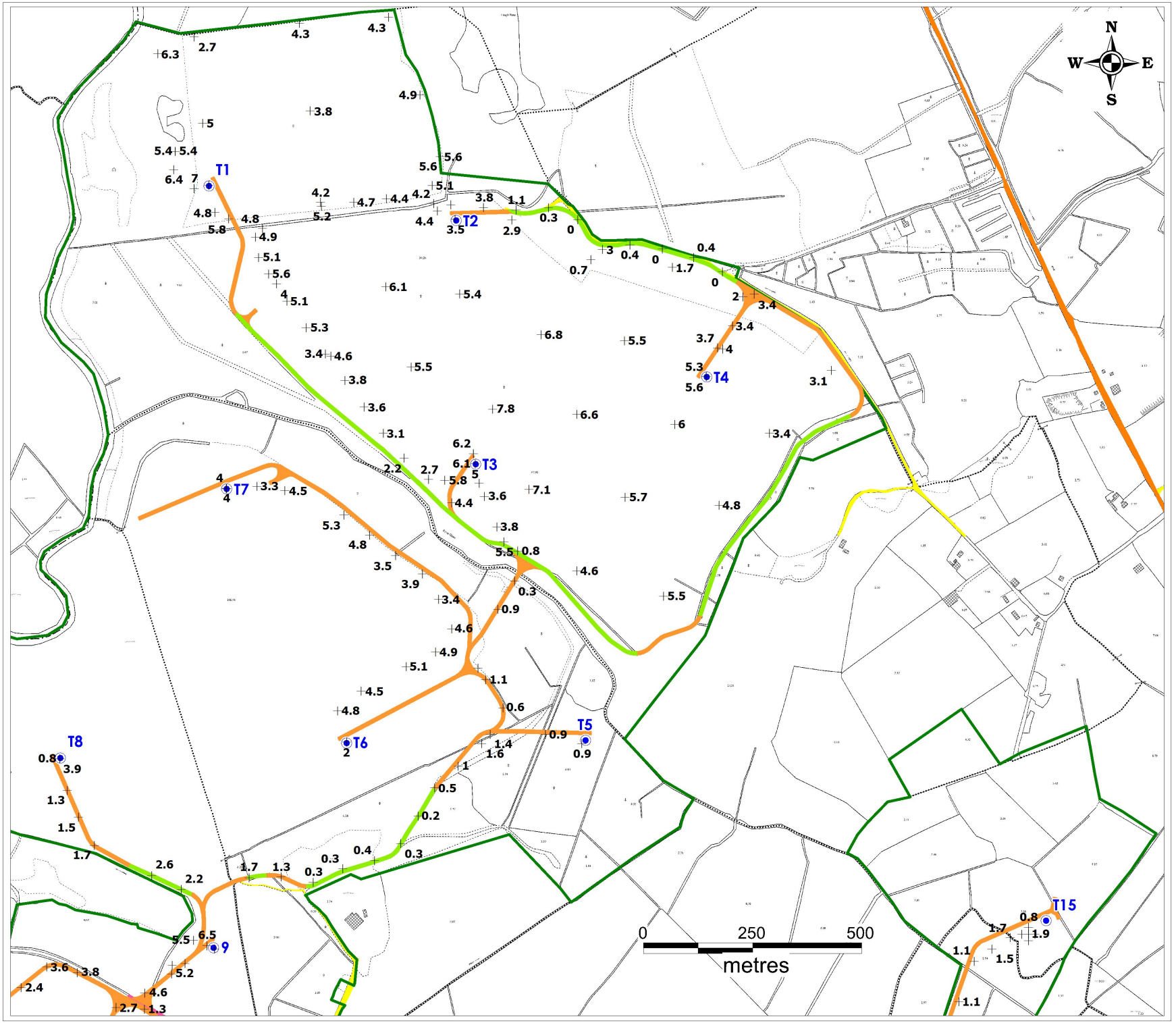

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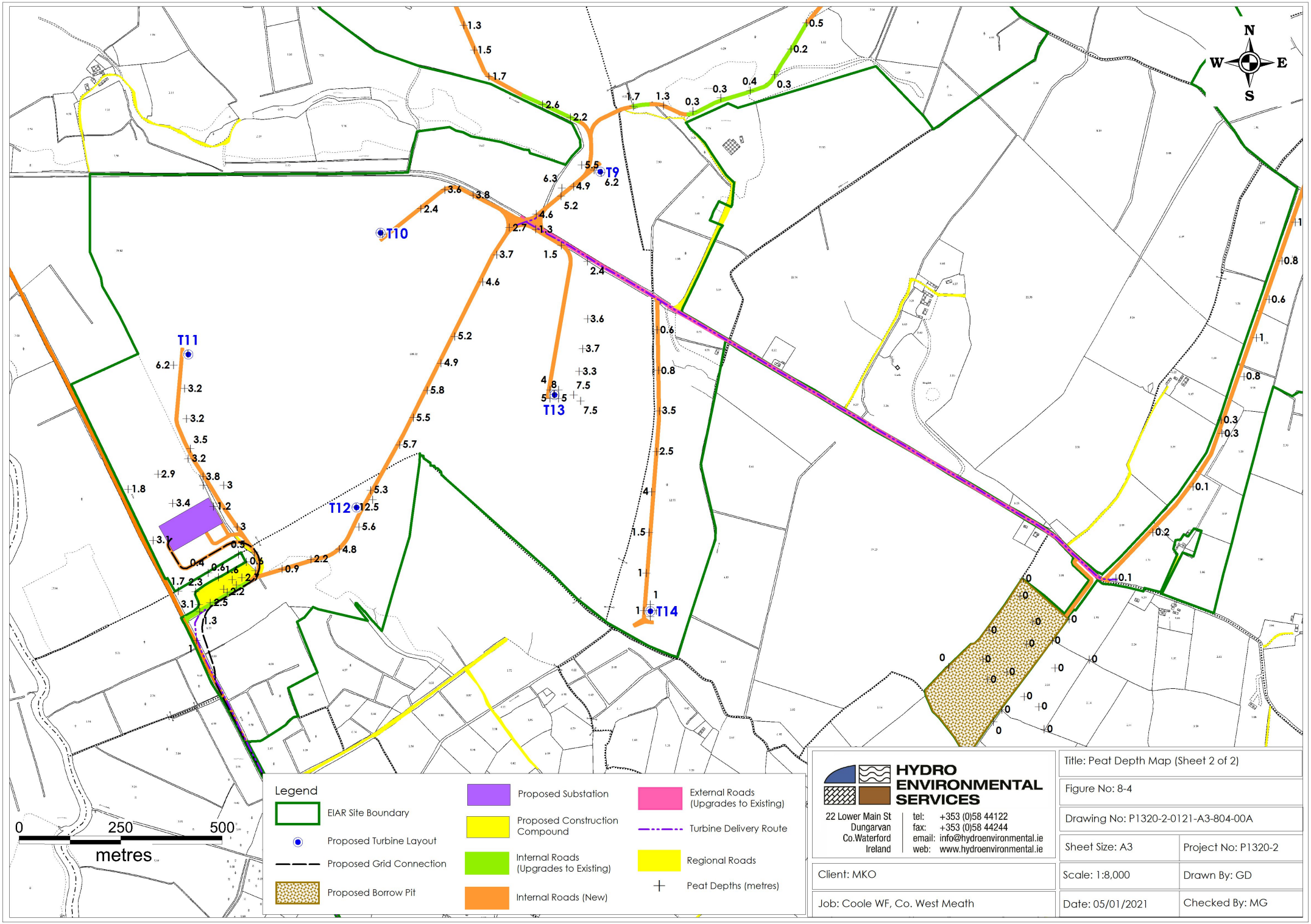
Client: MKO	
Job: Coole WF, Co. West Meath	
Title: Peat Depth Map (Sheet 1 of 2)	
Figure No: 8-3	
Drawing No: P1320-2-0121-A3-803-00A	
Sheet Size: A3	Project No: P1320-2
Scale: 1:8,000	Drawn By: GD
Date: 05/01/2021	Checked By: MG



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Title: Peat Depth Map (Sheet 2 of 2)	
Figure No: 8-4	
Drawing No: P1320-2-0121-A3-804-00A	
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Client: MKO	Scale: 1:8,000
Job: Coole WF, Co. West Meath	Date: 05/01/2021
	Drawn By: GD
	Checked By: MG

Table 8-4: Summary of Peat Depths and Mineral Subsoil Lithology at Proposed Development Locations within the wind farm site (2016/2017 & 2020)

Location	Average Peat Depth (m)	Summary of Underlying Mineral Subsoil Lithology (from AGEC/FT site data)	Slope Angle
T1	6.6	Shell marl, underlain by lacustrine clay	2.0
T2	4.0	Shell marl, underlain by lacustrine clay	2.0
T3	5.9	Shell marl, underlain by lacustrine clay	2.0
T4	5.3	-	1.0
T5	0.6	-	2.0
T6	4.6	-	2.0
T7	3.4	Shell marl, underlain by lacustrine clay	1.0
T8	3.6	Shell marl, underlain by lacustrine clay, with grey sandy GRAVEL at 8.1mbgl	2.0
T9	6.0	Shell marl, underlain by lacustrine clay, with grey sandy silty GRAVEL at 8.0mbgl	3.0
T10	4.6	-	2.0
T11	5.6	Shell marl, underlain by lacustrine clay, with dense gravelly SAND at 6.78mbgl	1.0
T12	4.9	-	3.0
T13	5.4	Shell marl, underlain by lacustrine clay, with grey, clayey/silty GRAVEL at 9.35mbgl	2.0
T14	1.0	Hard mineral soil base	1.0
T15	1.5	Hard gravelly mineral soil base	1.0
Substation	2.0	Grey sandy silty CLAY over grey sub angular-sub rounded gravel.	2.0
Construction Compound	1.6	Wet, coarse, silty, sandy, angular (limestone) GRAVEL, and Angular weathered limestone bedrock	1.0
Link Road	1.8	-	0.5-3.0
Borrow Pit	0	Typically consisting of angular gravels, cobbles and boulders of weathered limestone in a clay matrix. Weathered bedrock was typically encountered between 0.2m and 1.3mbgl. Bedrock comprises of strong intact limestone at typically 1.5mbgl.	variable

Table 8-5: Summary of Rotary Core borehole logs at Proposed Development Locations within the wind farm site (2020)

Location	Peat Depth (m)	Summary of Underlying Lithology (from Ground Investigations Ireland Rotary Core Boreholes)	Slope Angle
T1	5.0	0-5m: Black peat (3.5m) over Yellowish brown sandy Peat 5-6.5m: Very soft brownish grey Shell marl 6.5-11m: Grey slightly sandy clayey Silt 12-14.75m: Limestone gravel and cobbles 14.75-23.0m: Weak to medium strong Limestone	2.0
T2	3.5	0-3.5m: Black peat 3.5-6.5m: Grey silty Clay 6.5 – 9.8m: Dense, dark grey Gravel and Cobbles 9.8 - 20m: Weak-Medium Strong grey/dark grey Limestone	2.0
T3	5.0	0-5m: Soft dark brown Peat 5-6.5m: Soft sandy Silt 6.5 – 8m: Shell Marl 8-13.6m: Grey Silty Clay 13.6 – 21.5m: Medium strong dark grey Limestone	2.0
T4	5.3	0-5.3m: Soft dark brown fibrous Peat 5.3-6.5: Shell marl 6.5-8.85m: Firm grey slightly silty Clay 8.85- 17m: Medium strong to strong dark grey Limestone	1.0
T5	N/A	N/A	2.0
T6	2.0	0-2m: Soft dark brown fibrous Peat 2-16.9: Firm to stiff Clay with poor recovery 16.9-27.5m: Dark grey fine-grained Limestone	2.0
T7	3.5	0-3.5m: Very soft dark brown fibrous Peat 3.5-6.5: Shell marl 6.5 – 14: Silty Clay 14-15.35: Grey Boulder Clay 15.35-21.5m: Medium strong, thickly bedded grey Limestone	1.0
T8	0	0-3.5m: Soft brown sandy Silt w/ some organic material 3.5 - 7.0m: Soft grey sandy Silt 7.0 – 12.8m: Grey sandy, gravelly Clay 12.8 – 19.8m: Medium strong, dark grey Limestone	2.0
T9	5	0-5m: Dark brown fibrous Peat 5-12.5m: Gravels with cobbles	3.0

Location	Peat Depth (m)	Summary of Underlying Lithology (from Ground Investigations Ireland Rotary Core Boreholes)	Slope Angle
		12.5 – 14.7m: Stiff dark grey, slightly sandy gravelly Clay 14.7 – 22.3m: Dark grey, fine-grained Limestone	
T10	6.5	0-6.5m: Dark brown fibrous Peat 6.5 – 11.85m: Boulder Clay 11.85 – 23m: Grey, fine-grained Limestone	2.0
T11	6.5	0-6.5m: Dark brown soft Peat 6.5 – 8.7m: Fine to coarse gravels/cobbles 8.7 – 17m: Dark grey Fine-grained Limestone	1.0
T12	12.5	0-12.5m: Soft, dark brown fibrous Peat 12.5 – 14.85m: Grey silty Clay over gravel/cobbles 14.85 – 24.5m: Dark grey, fine-grained Limestone	3.0
T13	8	0-8m: Soft, dark brown fibrous Peat 8-9.3m: Soft, brownish grey sandy Silt 9.3 - 14.05m: Black gravelly Clay 14.05 – 20m: Medium strong, fine grained Limestone	2.0
Substation	2	0-2m: Soft, dark brown fibrous Peat 2-3.5m: Stiff grey sandy silty Clay 3.5 – 6.05m: Dense grey medium to coarse Gravel 6.05 – 12.5m: Medium strong, dark grey, fine-grained Limestone	1.0

Note: No Rotary core boreholes could be performed at T14 and T15 due to site access restrictions

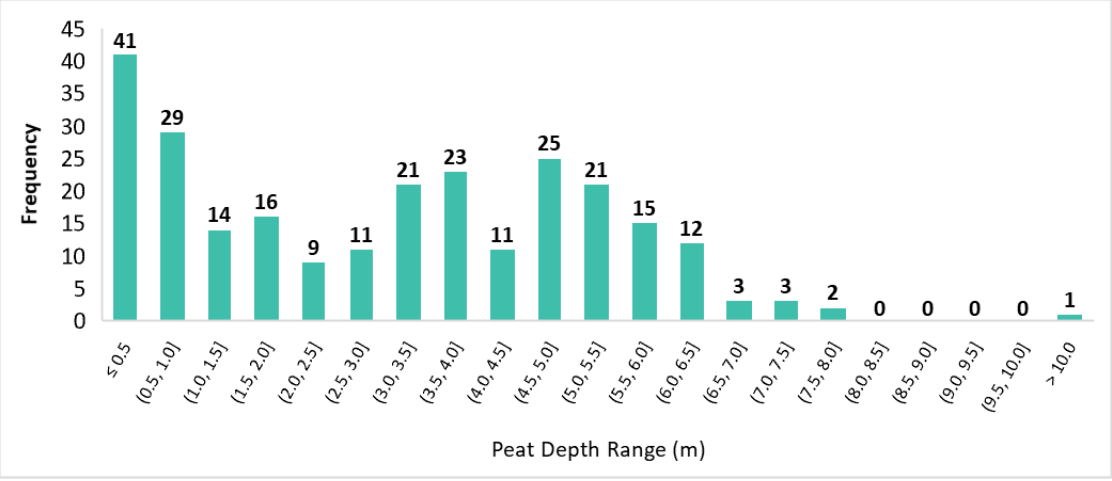

Figure 8A Wind Farm Site - Peat Depth Distribution

13 no. boreholes were drilled across the proposed Wind Farm Site. These boreholes typically encountered black – dark brown peat ranging in depth from 2-12.5m. The peat was generally underlain

by a mixture of grey sandy silt, shell marl or silty clay, which was in turn underlain by dark grey, fine grained Limestone bedrock.

8.3.2.2 Grid Connection Route

The published soils map (www.epa.ie) for the area indicates that the majority of the Grid Connection Route, north of Multyfarnham, including the area of the proposed onsite substation, is mapped as cut over peat, while the area around Coole village is mapped as basic, well drained mineral soil (BminDW). South of Multyfarnham, soils are mapped as being predominantly acidic, well drained mineral soil (AminDW) with some pockets of Fen Peat. The soils between the southern tip of Lough Owel and Mullingar town are mapped as BminDW.

Subsoils in the area are mapped by the GSI as generally cut over raised peat and Tills derived from Limestone north of Multyfarnham, transitioning to Tills derived from chert, raised peat and minor areas of Tills derived from Limestone. A map of the local subsoil cover is shown in Figure 8-1 (www.gsi.ie).

Intrusive Investigations

Site investigations along the Grid Connection Route were completed in 2017. At that time a total of over 80 no. peat probes were undertaken by AGEC Ltd along the Grid Connection Route. Peat was encountered in 32 of the 80 no. probes. The locations of the survey points are included as Figures 1-3 in Appendix 4-4.

Overall, peat depths recorded during the peat probing investigation ranged from 0 to 6.3m with an average of 1.8m. Approximately 75% of the peat probes recorded peat depths of less than 1.25m with 95% recording depths less than 4.25m (refer to below for a peat depth distribution plot). The maximum peat depth recorded along the grid route was 6.3m, recorded ~600m northwest of the Crannóg at Lough Derravaragh (E638874, N767127).

To assess the geological and geotechnical conditions along the Grid Connection Route, shear vane strength tests were also performed at the 80 no. locations, where peat was intercepted. The shear vane strength of the peat ranged from 20 – 80 kPa, with most values falling within the range of 40 – 60 kPa. A summary of the peat depths and shear vane strength is shown in below in Table 8-6, along with a peat depth distribution graph included as Figure 8B. The original data is included within Appendix 4-4.

Table 8-6: Summary of peat depths and shear vane strength along Grid Route Connection (AGEC 2017)

Survey Point	Easting	Northing	Peat Depth (m)	Depth of shear vane test (m)	Peat strength (kPa)
1 E	639942	774293	0.9	0.5	48
1 W	639932	774293	0.3	-	
2 E	640039	774118	1.8	1.0	36
2 W	640029	774118	0.2	-	-
3 W	640127	773944	0.9	-	-
7 S	639859	770162	0.9	-	-
9 S	639468	770075	0.9	0.5	20
15 W	638611	769750	3.1	1.0	30
16 E	638623	769550	1.8	1.0	63
16 W	638613	769550	1.8	-	-
17 E	638626	769350	0.9	-	-
18 W	638618	769150	1.8	1.0	48
19 E	638631	768950	1.5	0.3	50
19 W	638621	768950	1.5	0.5	58
20 E	638664	768753	2.9	1.0	20
20 W	638654	768753	0.9	0.5	58
24 E	638943	767318	0.5	-	-
24 W	638933	767318	0.5	-	-
25 E	638884	767127	4.0	1.5	40
25 W	638874	767127	6.3	2.0	70
26 E	638842	766932	2.5	0.5	42
27 E	638806	766735	2.9	0.5	42
27 W	638796	766735	0.5	-	-
28 W	638775	766536	4.5	2.0	50
29 E	638774	766337	0.9	-	-

Survey Point	Easting	Northing	Peat Depth (m)	Depth of shear vane test (m)	Peat strength (kPa)
29 W	638764	766337	1.5	1.3	46
30 E	638779	766137	1.5	-	-
31 E	638805	765939	2.3	0.6	80
32 E	638856	765746	1.5	1.0	42
32 W	638846	765746	4.3	2.0	36
33 E	638938	765565	0.2	-	-
33 W	638928	765565	2.0	0.7	20

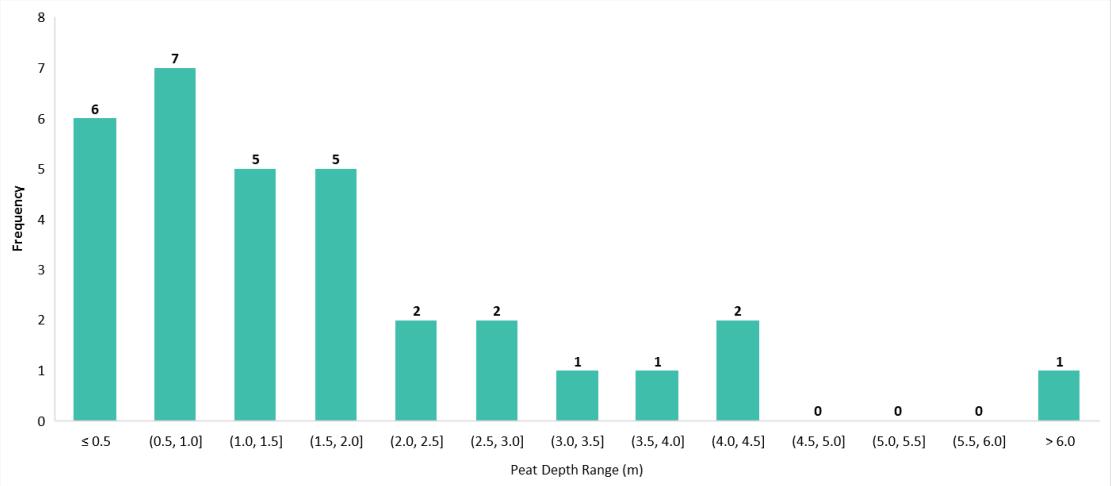

Figure 8B Grid Connection Route - Peat Depth Distribution

Further investigations were undertaken by APEX Geophysics Ltd. in September and October 2019, in conjunction with a geophysical survey. The geophysical survey was carried out between Multyfarnham and the Wind Farm Site, as this section of the Grid Connection Route contained sections of Bog rampart roads. Russian cores were performed at 13 no. locations (RS1-RS13) along this section of the Grid Connection Route to determine the thickness of peat and nature of the underlying strata. Peat thicknesses recorded from the cores ranged from 0.82 to 5.62m, with Shell Marl typically underlying the peat. The results of the survey are summarised below in Table 8-7. The original report is included as Appendix 4-5.

The peat depth data from the 13 no. Russian cores is consistent with the previous 80 no. peat depths conducted in 2017. Peat depths vary from 0.82 to 5.65m at the 13 no. locations, with peat generally <2.5m deep. The strata underlying the peat is typically Shell Marl, while soft grey clay was encountered at RS9, RS11 and RS12.

Table 8-7: Peat depths and substrate from 13 no. Russian Cores.

Survey Point	Chainage (m)	Peat Thickness	Sub-Peat
RS1	2420	2.66	Soft White Shell Marl
RS2	2682	2	Soft White Shell Marl
RS3	3031	4.7	Unknown, bog oak at base of peat
RS4	3257	2.45	Soft White Shell Marl
RS5	3443	3.6	Soft White Shell Marl
RS6	3739	5.65	Soft White Shell Marl
RS7	3975	0.82	Soft White Shell Marl
RS8	6262	1.1	Soft White Shell Marl
RS9	8268	3.43	Soft Grey Clay
RS10	8889	2.4	Soft White Shell Marl
RS11	9050	1.6	Soft White Shell Marl
RS12	14274	0.9	Soft Grey Clay
RS13	15098	1.1	Soft Grey Clay

Geophysical Survey

A Ground Penetrating Radar (GPR) survey was carried out between 17th-18th September and 3rd – 4th October 2019, along a section (~15.6 km long) of the Grid Connection Route, from Multyfarnham north to Coole. 7 no. GPR profiles, of differing lengths were conducted along the route. The higher GPR frequencies (providing higher resolution at shallower depths of penetration) were recorded along the entire route to image road construction material and lower GPR frequencies (providing a greater depth of penetration at a lower resolution) were recorded across areas of peat. The frequency and chainage length (chainage is the distance along the Grid Connection Route) of the GPR survey is included below as Table 8-8. The starting point, Ch0, is at the southern end of the 15.6km route near Multyfarnham.

Overall, the 250 MHz and 400 MHz surveys contained sufficient detail to image the road construction. The strata have been interpreted as containing an average of 0.213 to 0.941m of pavement material. Peat was resolved beneath 7 no. GPR sections with a maximum thickness of 5.34m at Ch 1602-3728m, which was correlated with Russian Cores. Shallow bedrock was also interpreted along six sections of the survey route (Chainages Ch 4486m, Ch 9755m, Ch10034m, Ch 10661m, Ch 11017m and Ch 12257m).

Table 8-8: GPR Frequency and chainage length with average peat/pavement depths and general description of strata

Chainage (m)		Average Pavement thickness (m)	Min Peat Depth	Max Peat Depth	Average Peat Thickness (m)	General Description
From	To					
0	1602	0.515	N/A	N/A	N/A	
1602	3278	0.765	0.833	5.34	2.645	Peat underlain by Shell Marl
3278	3355	0.914	N/A	N/A	N/A	Concrete Bridge Deck
3355	4055	0.779	0.664	5.140	3.676	Peat underlain by Shell Marl
4055	4486	0.341	N/A	N/A	N/A	
4486	4843	0.363	N/A	N/A	N/A	Possible Shallow Bedrock
4843	5342	0.504	N/A	N/A	N/A	
5342	6458	0.798	0.855	3.862	2.050	Peat underlain by Shell Marl
6458	7550	0.757	N/A	N/A	N/A	
7550	9119	0.882	0.426	4.883	2.709	Peat underlain by Shell Marl and Grey Clay
9119	9755	0.474	N/A	N/A	N/A	
9755	9851	0.270	N/A	N/A	N/A	Possible Shallow Bedrock
9851	10034	0.486	N/A	N/A	N/A	
10034	10240	0.525	N/A	N/A	N/A	Possible Shallow Bedrock
10240	10661	0.408	N/A	N/A	N/A	
10661	11017	0.444	N/A	N/A	N/A	Possible Shallow Bedrock
11017	11435	0.334	N/A	N/A	N/A	Possible Shallow Bedrock
11435	11528	0.340	N/A	N/A	N/A	

Chainage (m)		Average Pavement thickness (m)	Min Peat Depth	Max Peat Depth	Average Peat Thickness (m)	General Description
From	To					
11528	12257	0.319	N/A	N/A	N/A	
12257	12804	0.361	N/A	N/A	N/A	Possible Shallow Bedrock
12804	13814	0.424	N/A	N/A	N/A	
13814	14542	0.338	0.285	0.792	0.547	Peat underlain by Grey Clay
14542	15145	0.537	0.611	1.275	0.816	Peat underlain by Grey Clay, Possible reinforced concrete within road construction
15145	15662	0.213	0.392	0.775	0.572	Peat underlain by Grey Clay

8.3.3 Bedrock Geology

8.3.3.1 Wind Farm Site

The bedrock geology underlying the Wind Farm Site is mapped as the Lucan Formation which comprises dark limestone and shale. There are no mapped faults running through the Wind Farm Site. Bedrock was exposed during site investigation at the proposed construction compound within the Wind Farm Site, and also at the borrow pit area, and this comprised grey limestone [consistent with the mapped geology]. The bedrock geology map of the region, including the Grid Connection Route is shown as Figure 8-5.

The Lucan Formation is generally described as dark limestone and shale (calp). The Lucan Formation is a graded, intraclastic skeletal packstones interbedded with shales, laminated calcisiltites, argillaceous micrites and locally abundant chert representative of the basinal facies of the 'Calp'. Basal part of the Calp is dominated by dark grey, calcareous, bioturbated mudstones and wackestones also referred to at the Tober Colleen formation. In localised area in the south study area Mudbank limestone is mapped, which is typically described as massive grey micritic limestone.

No karst features were identified within the Wind Farm Site following a review of the GSI database or during the site walk-over. A number of karst features are noted to the east of the Wind Farm Site. The closest karst feature is located some 3km to the east of the Wind Farm Site where a spring was noted.

The bedrock encountered in trial pits at the proposed borrow pit location, and the fine-medium grained, medium-dark grey Limestone encountered within the 13 no. boreholes, is consistent with the description of the Lucan Formation.

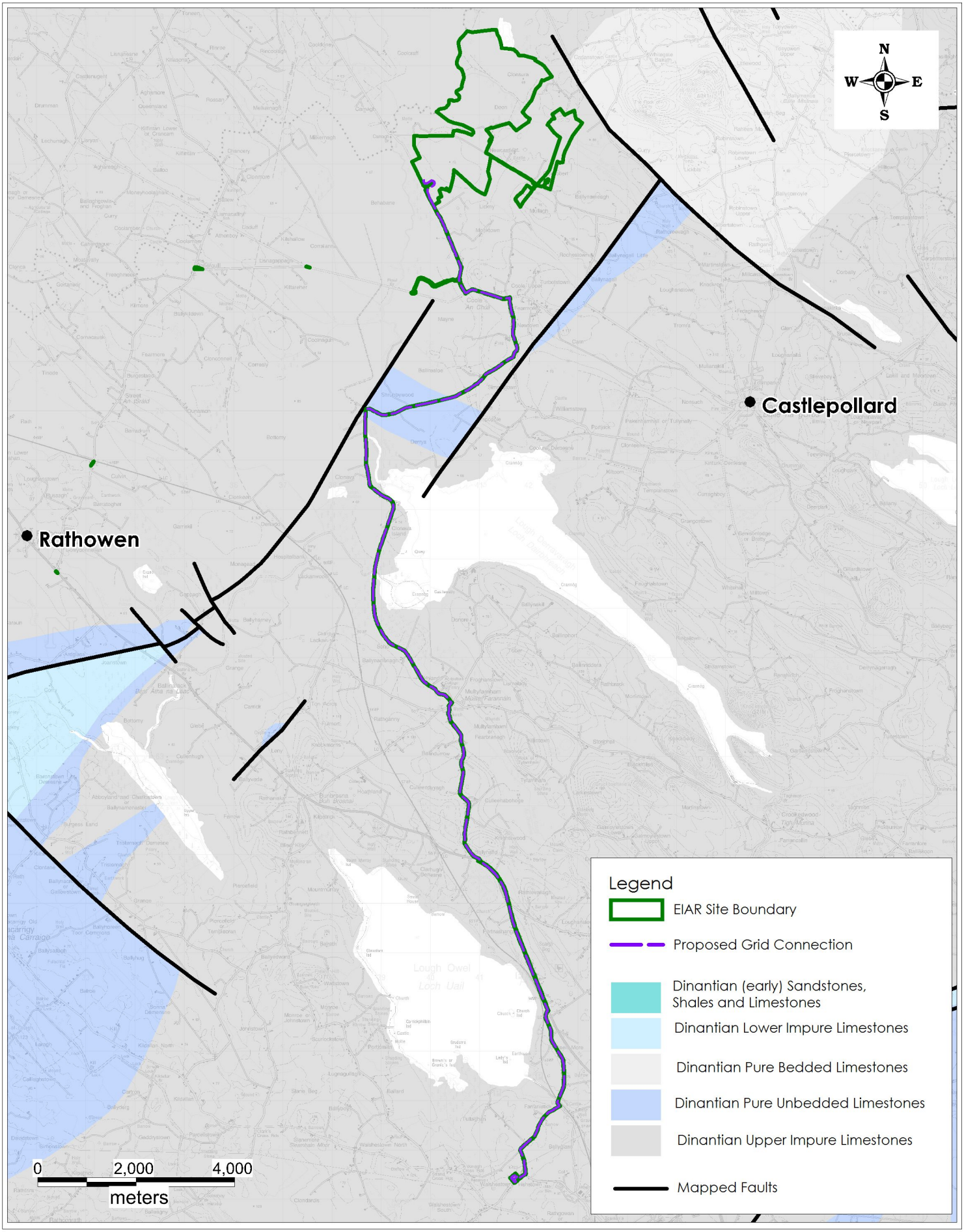

Figure No: 8-5	Client: MKO
Sheet Size: A4	Job: Coole WF, Co. West Meath
Date: 05/01/2021	Title: Local Bedrock Geology Map
Scale: 1:100,000	Project No: P1320-2
Drawn By: GD / Checked By: MG	Drawing No: P1320-2-0121-A4-805-00A

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8.3.3.2 Grid Connection Route

The underlying bedrock along the Grid Connection Route is mapped by the GSI as being a mixture of Lucan Formation dark limestone and shale and Derraveragh Cherts, cherty Limestone with minor shales.

The Lucan Formation (i.e. Calp Limestone) is mapped as underlying most of the northern and southern sections of the Grid Connection Route, in the general area of Coole and Mullingar. The Derravaragh cherts are mapped from Multyfarnham, south to the townland of Knockduff near the southern tip of Lough Owel. Two parallel faults juxtapose a section of the Derravaragh cherts southwest of Coole and just north of Derravaragh Lake. A bedrock geology map is included as Figure 8-5.

No bedrock was encountered during site investigation works completed along the Grid Connection Route. The geophysics surveys indicate shallow bedrock interpreted along six sections of the chainage route (Chainages Ch 4486m, Ch 9755m, Ch10034m, Ch 10661m, Ch 11017m and Ch 12257m). No depth to bedrock is estimated within this survey.

8.3.4 Soil Contamination

8.3.4.1 Wind Farm Site

There are no known areas of soil contamination on the Wind Farm Site. During the site walkovers, no areas of particular contamination concern were identified. The walkover also included area where machinery traffic would converge, such as loading areas, and compounds, and no areas of contamination concern were noted or observed.

According to the EPA online mapping (http://gis.epa.ie/Envision), there are no licenced waste facilities on or within the immediate environs of the proposed Wind Farm Site. There are no existing IE/IPC (Industrial Emission/Integrated Pollution Control) licenses granted within directly adjacent to the proposed Wind Farm Site. There are several IE/IPC licences locally and these mainly relate to remote (from the site boundary) farm/pig facilities.

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

8.3.4.2 Grid Connection Route

There are no known areas of soil contamination along the alignment of the Grid Connection Route. During the site walkovers, 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 Grid Connection Route.

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

8.3.5 Economic Geology

8.3.5.1 Wind Farm Site

The GSI Online Minerals Database accessed via the Public Data Viewer shows a small number of active and historic quarries, pits, mines and mineral occurrences near the Wind Farm Site. These consist of a marl pit, and limestone rock quarries. There is also evidence of pyrite mineral in two

mapped localities to the south of the Wind Farm Site. None of the overall localities are located within the overall Proposed Development study area. The nearest active bedrock quarries identified are Deerpark Quarry and Murrens Quarry, both limestone quarries located approximately 8.5 km southeast and east of the Wind Farm Site respectively. There is a small closed/recently active sand and gravel pit located between the southern and central bog basins of the Wind Farm Site. This old gravel pit is not located within the study area, but on adjacent private land.

The GSI online Aggregate Potential Mapping Database shows that the Wind Farm Site is not located within an area mapped as being of Very High or High granular aggregate potential (i.e. potential for gravel reserves). As mentioned above there is an old sand and gravel reserve mapped between the southern and central bog basins at the Wind Farm Site, but this gravel pit requires planning permission to be reactivated and is considered to have very low aggregate potential as it appears to be worked out. There is a high potential area mapped between the southern and central bog basins, but this does not form part of the Proposed Development site. There are areas of low and moderate aggregate potential mapped along the Inny River to the west of the Wind Farm Site. The bedrock which underlies the proposed Wind Farm Site, generally coincides with areas mapped as being of Low to Moderate for crushed rock aggregate (i.e. potential for a rock quarry).

There are a number of prospecting licences held for this area of County Westmeath for minerals including base metals, barytes, gypsum, gold and silver. There are drilling records for prospecting conducted in the 1980s' and in 1999. The 1980s' drillholes are located close to the Grid Connection Route, and the 1999 drillhole is located between the southern and central bog basin of the Wind Farm Site, close to T9. The latter indicated 21m of overburden over limestone bedrock (the Lucan Formation).

It is a policy (RUR DEV SO 3) of the Westmeath County Development Plan 2014 – 2020 '*To identify and protect known or potential aggregate resources, where feasible, from development which would prejudice their sustainable future usage'.* This is mirrored in policy RD POL 22 which states that it is a policy *'To facilitate the exploitation of the county's natural resources and to exercise appropriate control over the types of development taking place in areas containing proven deposits...'.* The core policy has been incorporated into in the Draft Westmeath CDP 2021-2027 (CPO 9.60) It is not envisaged that the Wind Farm Site will prejudice the future development of pits, quarries or mines in the area of the Wind Farm Site.

8.3.5.2 Grid Connection Route

The GSI online Aggregate Potential Mapping Database shows that the Grid Connection Route is located along an area which is typically classed as "Low" to "Moderate" in terms of crushed rock aggregate potential, with small sections of "Very High Potential" in the surrounding area of Multyfarnham. Small sections mapped as "Low to "Moderate potential in terms of granular aggregate potential (i.e. potential for gravel reserves) exist in Multyfarnham.

8.3.6 Geological Heritage Sites

There are no recorded Geological Heritage sites, mineral deposit sites or mining sites (current or historic) within the Wind Farm Site or Grid Connection Route. The Proposed Development footprint is not located within any designated site. The closest geological heritage site is the Hill of Mael (Rock of Curry) (Site Code – IGH12). This is located ~1km east of the Wind Farm Site and ~5km east of the Grid Connection Route. It has no connection to the Wind Farm Site or Grid Connection Route, and will not be affected in any way by the Proposed Development.

8.3.7 Peat Stability Assessment

8.3.7.1 Wind Farm Site

This section summarises the report on assessment of peat stability undertaken by AGEC Ltd (June, 2017) and updated by FTCO (October 2020) for the Wind Farm Site. The recorded peat depth data used to inform the peat stability assessment were completed by AGEC in December 2016, by HES in 2012 and 2016 and by FT in September 2020. Trial pits and window sampling conducted by HES in 2016 and site intrusive ground investigations by GII (July 2020) were also used to inform the assessment. The peat stability assessment report is included as Appendix 8-1 of this EIAR.

The purpose of the peat stability assessment was to determine the stability i.e. Factor of Safety (FoS), of the peat slopes where construction is proposed during the development of the wind farm. This involved geotechnical assessments of each of the infrastructure locations and included peat depth measurements and shear strength testing.

The findings, which involved analysis of over 200 no. locations, showed that the site has an acceptable margin of safety and is suitable for the proposed Wind Farm Site development. A 1.2km section of the wind turbine delivery route to the south of the wind farm which passes over an area of bogland, and peat areas along the Grid Connection Route, are included in the peat stability assessment. The findings include recommendations and control measures for construction work in peatlands to ensure that all works adhere to an acceptable standard of safety.

The analysis showed peat shear strengths in the range 13 to 98kPa, with an average value of 36kPa. The strengths recorded would be typical of well drained peat as is present on the Wind Farm Site. Peat strength at sites of known peat failures (assuming undrained loading failure) are generally very low, being approximately 2.5kPa. No such low shear strengths were recorded at the Wind Farm Site.

The minimum required Factor of Safety (FoS) is 1.3 based on BS6031:2009: Code of Practice for Earthworks (BSI, 2009). The assigned probability of instability associated with a given FoS value is described in Table 8-9 below.

Table 8-9: Probability Scale for Factor of Safety.

Scale	Factor of Safety	Probability
1	1.30 or greater	Negligible/None
2	1.29 to 1.20	Unlikely
3	1.19 to 1.11	Likely
4	1.01 to 1.10	Probable
5	<1.0	Very Likely

8.3.7.1.1 *Undrained Analysis*

Undrained analysis results are presented in Table 8-10. As outlined above the undrained loading condition applies in the short-term during construction and until construction induced pore water pressures dissipate.

Table 8-10: Factor of Safety Results (undrained condition)

Turbine No./Waypoint	Easting	Northing	Factor of Safety for Load Condition	
			Condition (1)	Condition (2)
T1	240910	277329	2.46	2.15
T2	241477	277250	3.91	3.19
T3	241521	276690	2.82	2.42
T4	242051	276891	6.14	5.21
T5	241774	276057	19.11	9.05
T6	241226	276051	3.58	2.97
T7	240951	276634	8.60	6.88
T8	240569	276017	4.41	3.51
T9	240920	275581	1.85	1.59
T10	240380	275431	3.31	2.77
T11	239907	275132	5.55	4.78
T12	240321	274755	2.17	1.82
T13	240808	275032	2.29	2.02
T14	241043	274499	34.38	17.19
T15	242790	275610	18.1	11.86
Substation	239967	274699	5.38	4.10
Construction Compound	239995	274559	11.09	8.39
Link Road (16 no)	varies	varies	>8.6	>5.73
Borrow Pit	241949	274362	No peat recorded	

8.3.7.1.2 Drained Analysis

Drained analysis results are presented in Table 8-11. As outlined above, the drained loading condition applies in the long-term. The condition examines the effect of in particular, the change in groundwater level as a result of rainfall on the existing stability of the natural peat slopes.

Table 8-11: Factor of Safety Results (drained condition)

Turbine No./Waypoint	Easting	Northing	Factor of Safety for Load Condition	
			Condition (1)	Condition (2)
T1	240910	277329	1.64	3.10
T2	241477	277250	2.61	4.60
T3	241521	276690	1.88	3.50
T4	242051	276891	4.09	7.52
T5	241774	276057	12.74	13.06
T6	241226	276051	2.39	4.28
T7	240951	276634	5.73	9.93
T8	240569	276017	2.94	5.07
T9	240920	275581	1.23	2.30
T10	240380	275431	2.21	4.00
T11	239907	275132	3.70	6.89
T12	240321	274755	1.44	2.63
T13	240808	275032	1.53	2.92
T14	241043	274499	22.92	24.82
T15	242790	275610	12.06	17.12
Substation	239967	274699	3.58	5.91
Construction Compound	239995	274559	7.39	12.11
Link Road (16 no)	varies	varies	>5.73	>8.27
Borrow Pit	241949	274362	No peat recorded	

The FoS for turbine T9 in a drained condition is 1.23 which is less than the 1.3 required in the BS6031:2009: Code of Practice for Earthworks. However, in their peat stability assessment (Appendix 8-1) AGEC Ltd clarify that the lower FOS corresponds to an area of deeper peat which is located in a topographical depression and would not be at risk from a peat slide. The risk at turbine T9 relates to a safety risk during construction which will be mitigated by adopting the methods and measures outlined in Appendix B of the FTCO report. These are also included below at Section 8.5.1.4.

The risk rating for the other infrastructure element at the Wind Farm Site is designated trivial following mitigation/control measures being implemented. Sections of access roads to the nearest infrastructure element will be subject to the same mitigation/control measures that apply to the nearest infrastructure

element. Specific control measures for each infrastructure type are provided in the FTCO Ltd report to manage all risks associated with peat instability. These are also included below at Section 8.5.1.4.

8.3.7.2 Grid Connection Route

This section summarises the report on assessment of peat stability undertaken by AGEC Ltd. The peat stability assessment report is included within Appendix 4-4 of this EIAR.

A geotechnical assessment of the Grid Connection Cable Route was completed by AGEC between the 4th and 5th of April 2017. This assessment report is attached as Appendix 4-4 of this EIAR. The geotechnical assessment report includes the results of a walkover survey of the ground conditions along the three (3) priority areas for the Grid Connection Route as well as the results of an indicative stability analysis in accordance with Eurocode 7 (Design Approach 1, Condition 2) on a typical section of the road embankment with a trench located at the edge of the road embankment (for example) and construction plant located on the road. The report also includes typical trench details for sections of the Grid Connection Route and possible construction options for areas of deeper peat.

The AGEC report includes the following:

- Probing data from the verges on both sides of the road at approximately 200 m intervals along the three (3) priority areas to determine the ground conditions including the thickness of peat and / or soft ground;
- Shear vane test results in peat at various locations along the three (3) priority areas;
- Salient observations on ground conditions and drainage;
- The results of peat stability analysis carried out on a typical road section to determine if a cable trench along with construction equipment on the road would cause instability of the road.

A minimum safety factor of 1.24 was achieved, within Scale 2 of the Probability Scale (refer to Table 8-11) indicating that the stability of the road is unlikely to be an issue with a trench in place. The original peat stability assessment data is contained within Appendix 4-4.

The main findings of the AGEC Cable Route Assessment Report are as follows:

- Based on the information obtained during the site walkover, installation of the cable trench within the road or road verges is feasible. (Specific trench design has been provided by Ionic Consulting, which will allow the cable to be placed in the bog rampart sections of the road while maintaining the structural integrity of the road.) Once the cable is laid in the roads, the trench will be backfilled to appropriate standards and the road surface reinstated as directed by Westmeath County Council; and,
- A stability analysis shows that the inclusion of the cable trench would not reduce the stability of the existing road embankments.

The construction methodology of providing a Grid Connection Route under and along local road networks is well established and accepted nationwide. There are in excess of 300 wind farms currently operational in the Republic of Ireland and the majority of these would be connected to the national grid via underground cable connections predominantly along the public road network. Also, engineering designs as specified in this EIAR have been accepted by Roads Departments in other Local Authorities for recently built and permitted projects in peatland environments such as at Clare County Council (Slievecallan Wind Farm; requires c34km of underground grid connection from Slievecallan in West Clare to Ennis which originates in an upland peat environment) and Mayo County Council (permitted Magheramore Wind Farm; under Decision P16/472 requires 5.3km of underground cabling from the wind farm site to the substation in Claremorris included roads located on and adjacent blanket peat).

The update to the national wind energy guidelines have clarified that the preferred means of connecting to the national grid is via underground cabling. In terms of minimising environmental impacts arising from the construction process the preferable route (in terms of assessing alternatives) is to provide cabling along public road corridors in favour of placing the cables under green fields. Laying the cables along existing public road corridors facilitates access for construction and also minimises the extent of green field construction required to facilitate the Proposed Development. It is also similar in nature to waterpipe-laying which is completed along public road networks by Local Authorities across the country.

Chapter 4, Section 4.8.7 includes information on the reinstatement works to be carried out on public roads following cable installation.

8.4 Characteristics of the Proposed Development

The Proposed Development is defined in Section 4.1 of Chapter 4. The main characteristics of the Proposed Development that could impact on soils and geology, and hydrogeology (which is dealt with in Chapter 9) are:

- Opening of the on-site borrow pit, which will involve the stripping of topsoil/subsoil and rock extraction, and subsequent processing, of approximately 251,915m^3 of suitable rock to create aggregate for use on site in access tracks and hardstand construction. As detailed in Chapter 4, Section 4.3.9 this estimate includes for a 25% contingency in materials requirement.
- Establishment of the site compound, which will involve minor regrading of peat and the placement of the construction compound using a floated technique where possible. Welfare facilities will be provided at the site compounds. Wastewater effluent will be collected in a wastewater holding tank and periodically emptied by a licensed contractor.
- Construction of the site access tracks which will largely use both floated technique, with some excavate and replace technique required in transition zones where shallow peat occurs. Floating tracks will be used at the site for the majority of new tracks, as well as upgrading of existing tracks which will include some small areas of excavate and replace construction method. This will involve the use of aggregate, sourced from the on-site borrow pit and imported from local quarries where required.
- Construction of the cranage areas and turbine assemblage areas are assumed to be floated, apart from at T5 and T15. This construction will also involve the use of aggregate, sourced from the onsite borrow pit and imported from local quarries where required.
- With the exception of turbine T5 and T15, all turbines and their associated crane hardstands are likely to require a piled foundation as a result of the depth of peat and soft lacustrine deposits present. In addition, it is likely that a piled foundation will be required for the substation building. The substation platform and construction compound platform will likely be constructed using floating techniques.
- Estimated volumes of peat to be removed at T5 and T15, are estimated ~ 4,630m^3.
- Settlement ponds, where constructed, will be volume neutral, *i.e.* all material excavated will be used to form side bunds and landscaping around the ponds. There will be no excess material from settlement pond construction. The material will also be reinstated during decommissioning.
- Construction of the onsite substation and parking area will be completed using a floated technique. Welfare facilities will be provided at the substation. Wastewater effluent will be collected in an underground concrete holding tank and periodically emptied by a licensed contractor for the operational phase of the Proposed Development.
- Grey water will be supplied by rainwater harvesting and water tankered to site where required. Bottled water will be used for potable supply.
- Construction of the turbine foundations, which will require large volumes of concrete. (approximately 550m^3 per turbine foundation plus approximately 50m^3 of lean-mix

concrete for the blinding layer), placing demand on local concrete batching plants / quarries.

- Cabling between turbine locations and the onsite substation. This will involve the excavation of a shallow trench (approximately 1.2m deep), placement of ducting and backfilling with aggregate, lean-mix concrete and excavated material, as appropriate (depending on the location of the cable trench).
- Cabling between the site substation and the Mullingar 110 kV Substation. This will involve the excavation of a trench along the public road, placement of ducting and backfilling with lean-mix concrete and compacted engineered fill.
- Link Road, Junction Accommodation and Public Road Works, including:
    - 1: N4/L1927 junction at Joanstown - temporary hardcore surfacing area and visibility splays. The proposed area for temporary hardcore surfacing measures approximately 0.03 hectares.
    - 2: Railway Line Level Crossing on the L1927 – no alteration of crossing, swept path analysis indicates turbine vehicles will be able to negotiate this crossing with Temporary removal of the existing hedgerow and hardsurfacing South of the railway line to the East .
    - 3: L1927/L5828 right turn at Boherquill - temporary hardcore surfacing area and visibility splays, widen northeastern corner of junction. Proposed hardcore area measures 0.31 hecatres.
    - 4: Right turn from L5828 onto R395 - no alteration of road, swept path analysis indicates turbine vehicles will be able to negotiate this crossing with minor impacts on grass verges requiring temporary hardcore.
    - 5&6: Site access junctions A and B that provide access/egress onto proposed link road (linking R395 and R396) - with temporary hardcore surfacing and visibility splays at the turning areas. The proposed area for surfacing measures 0.34 hectares.
    - 7: Site access junction C that provides access to the site from the R396 - temporary hardcore surfacing area and visibility splays will be required at this junction. The proposed area for hardcore surfacing measures 0.21 hectares.
    - 8: Site access junction D which crosses the L5755 - no alteration of road, swept path analysis indicates turbine vehicles will be able to negotiate this crossing with minor impacts on sections of hedge (over-sail) and grass verges.
    - 9: Site access junction E which provides access to Turbine T14 located south of L5755 - temporary hardcore surfacing area and visibility splays will be required at this junction. The proposed area for hardcore surfacing measures 0.21 hectares.
    - 10: Site access junction F, access junction off the L5755 to / from the proposed borrow pit - visibility splays will be required at this junction.
    - 11: Site access junction G which provides access to turbine number 15 situated to the north of the L5755 - temporary hardcore surfacing area and visibility splays will be required at this junction. The proposed area for hardcore surfacing measures 0.8 hectares.
- The proposed link road measures 1.2 kilometres in length, and will traverse land currently occupied by commercial cutover peat and agricultural grassland between the R395 and R396 Regional Roads.
- Tree felling and replanting. 2 no. turbines are located in commercial forestry (T5 & T14) which will require felling, and replanting of forestry at alternative replacement lands. While this work will be done with Forestry Service licenses and approvals, the works could result in soil/subsoils erosion.

8.5 Potential Impacts of the Proposed Development

8.5.1 Likely Impacts and Mitigation Measures – Construction Stage

The likely impacts of the Proposed Development, including construction works at the Wind Farm Site and along the Grid Connection Route, 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.

8.5.1.1 Peat, Subsoil Excavation and Bedrock Excavation

Excavation of peat, mineral subsoil and bedrock will be required for the installation of parts of the access roads, link road, turbine hardstands and bases, onsite substation, for landscaping, and cable trenching within the Wind Farm Site, and for the Grid Connection Route cable trench. Minor excavations will take place at junction improvement works. In addition, minor disturbance of soils and peat are likely to occur during tree felling operations. These works will result in temporary disturbance or permanent removal of peat, subsoil and bedrock at various excavation locations. The majority of subsoil excavated along the Grid Connection Route will however be reinstated back within the trench. Minor haul route works will have minimal impact on soils and geology.

The local bedrock (extracted at the proposed borrow pit) can be classified as of "Medium" importance, and is abundant in the area, therefore local excavation at the borrow pit has little or no significance.

The soil/subsoil can be classified as of "Medium" importance. The peat deposits at the site could be classified as of "Low" importance as the raised bog is already degraded by commercial peat cutting, forestry works and extensive drainage works.

Pathway: Extraction/excavation.

Receptor: Peat, mineral subsoils and bedrock.

Pre Mitigation Potential Impact: Negative, slight/moderate, direct, high probability, permanent impact on peat, mineral subsoil and bedrock.

Proposed Mitigation Measures by Design:

- Placement of turbines and associated infrastructure in areas with shallower peat where possible;
- Use of piled foundations in areas of deeper peat and soft mineral soils;
- Use of floating roads (where geotechnically acceptable to do so) to reduce peat excavation volumes (i.e. along wind farm access tracks and the link road);
- The peat and subsoil which will be removed during the construction of turbine hardstands (will be localised to the turbine locations. The peat will be placed/spread locally alongside the excavations (refer to Figure 7-1 of Appendix 4-2);
- Small volumes of peat will be excavated and used for landscaping along proposed access/link roads;
- No turbines or related infrastructure will be constructed in any designated sites such as NHAs or SACs;
- Construction of settlement ponds will be volume neutral, and all excess material will be used locally to form pond bunds and surrounding landscaping;

- Placement of internal cable trenching will also be volume neutral, and all excess material will be used locally as landscaping;
- Subsoils will be reinstated back into the cable trench along the proposed grid connection route where possible; and,
- Peat/mineral soil excavated along the Grid Connection 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 Grid Connection Route.

Residual Effect: The granular soil at the site can be classified as of "Medium" importance and the peat deposits at the site can be classified as of "Low" importance as the raised bog is already degraded by historical harvesting and drainage. The overall site area is extensive while the Proposed Development footprint is approximately 5% of the overall Wind Farm Site area. The impact is the disturbance and relocation of c 97,980 m^3 of soil and subsoil during construction, 74,400m^3 of which will be taken from and subsequently reinstated back into the borrow pit. The design measures incorporated into the project as described above in particular the avoidance of deeper peat areas combined with the 'Medium' and 'low' importance of the deposits means that the residual effect is considered - Negative, direct, slight, high probability, permanent impact on peat, mineral subsoils, and bedrock.

Significance of Effects: For the reasons outlined above, no significant impact on soils, subsoils or bedrock are anticipated.

8.5.1.2 Contamination of Soil by Leakages and Spillages and Alteration of Peat/Soil Geochemistry

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 peat, subsoils and pollution of the underlying aquifer) on the geological and water environment, depending on where a spill may occur, *i.e* Wind Farm Site including junction improvement works areas and Grid Connection Route.

Pathway: Peat, mineral subsoil and bedrock pore space.

Receptor: Peat, mineral subsoil and bedrock.

Pre-Mitigation Potential Impact: Negative, direct, slight, short term, medium probability impact on peat, soils and bedrock.

Proposed Mitigation Measures:

- Where possible maintenance of construction vehicles or plant will take place off-site. This applies to both at the Wind Farm Site and along the Grid Connection Route. 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 bunded locations.;
- The electrical control building at the Wind Farm Site 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 Grid Connection 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 4-8 of this EIAR. Spill kits will be available to deal with accidental spillage in and outside of re-fuelling areas.

Residual Effect: 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 is considered to be - Negative, imperceptible, direct, short-term, low probability effect on peat and subsoils and bedrock.

Significance of Effects: For the reasons outlined above, no significant impact on soils, mineral subsoils or bedrock are anticipated.

8.5.1.3 Erosion of Exposed Subsoils and Peat During Tree Felling, Access Road, Turbine Base Construction Work and works along the Grid Connection Route

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 Wind Farm Site including link road, junction improvement areas and Grid Connection Route.

Pathway: Vehicle movement, surface water and wind action.

Receptor: Peat, subsoil & weathered bedrock.

Pre-Mitigation Potential Impact: Negative, direct, slight, high probability impact on peat, subsoils and bedrock.

Proposed Mitigation Measures:

- Peat removed from the turbine locations and associated access roads will be used for landscaping, or placed/spread locally alongside the excavation. A full Peat and Spoil Management Plan for the Proposed Development is shown as Appendix 4-2.
- In order to minimise erosion of mineral subsoils, stripping of peat will not take place during extremely wet periods (to prevent increased silt-rich runoff). Temporary drainage systems will be required to limit runoff impacts during the construction phase.
- In forestry areas brash mats will be used to support vehicles on soft ground, reducing peat and mineral soils 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.
- Peat and subsoil removed from the cable trench will be used to reinstate the trench where possible or removed to an appropriately licenced facility. Peat and subsoil removed from the proposed substation groundworks will be removed and either used for Wind Farm Site reinstatement/landscaping works or taken to an appropriately licenced facility.

Residual Effects: Peat soils and spoil can be eroded by vehicle movements, wind action and by water movement. To prevent this all excavation works will be temporary, stockpiles will be covered, and silt fencing will be used. Following implementation of these measures the residual effected is considered to be - Negative, slight, direct, likely impact on peat and subsoils, and possibly bedrock.

Significance of Effects: For the reasons outlined above, no significant impact on soils, subsoils or bedrock are anticipated.

8.5.1.4 Peat Instability and Failure

Peat instability or failure refers to a significant mass movement of a body of peat that would have an adverse impact on proposed wind farm development and the surrounding environment. Peat failure excludes localised movement of peat that could occur below an access road, creep movement or erosion type events. The consequence of peat failure at the Wind Farm Site / along the Grid Connection Route may result in:

- Death or injury to site personnel;
- Damage to machinery;
- Damage or loss of access tracks or roads;
- Drainage disrupted;
- Site works damaged or unstable;
- Contamination of watercourses, water supplies by particulates;
- Degradation of the peat environment.

Pathway: Vehicle movement and excavations.

Receptor: Peat subsoils.

Pre Mitigation Potential Impact: Direct, negative, significant, low probability impact on peat and subsoils.

Proposed Mitigation Measures: The risk rating for each infrastructure element at the Proposed Development is designated trivial following mitigation/control measures being implemented. Sections of access roads to the nearest infrastructure element will be subject to the same mitigation/control measures that apply to the nearest infrastructure element. Mitigation by design is achieved along the Grid Connection Route through the use of the trenching methodologies outlined in Section 2.2 (Appendix 4-3). A number of control measures are given in the AGEC Ltd 2017 peat stability (Appendix 8-1) and AGEC Ltd 2019 peat stability (Appendix 4-4) assessments to manage all risks associated with peat instability. These are outlined below.

The following general measures incorporated into the construction phase of the project will assist in the management of the risks for the Wind Farm Site and Grid Connection Route:

- Appointment of experienced and competent contractors;
- The site should be supervised by experienced and qualified personnel;
- Allocate sufficient time for the project (be aware that decreasing the construction time has the potential to increase the risk of initiating a peat movement);
- Prevent undercutting of slopes and unsupported excavations;
- Maintain a managed robust drainage system;
- Prevent placement of loads/overburden on marginal ground;
- Set up, maintain and report findings from monitoring systems;
- Ensure construction method statements are followed or where agreed modified/ developed; and,
- Revise and amend the Geotechnical Risk Register as construction progresses.

Residual Effects: A detailed Geotechnical Stability Assessment has been completed for the Proposed Development, Appendix 8-1 and 4-4 of this EIAR. The findings of these assessments have demonstrated that there is a low risk of peat failure as a result of the Proposed Development. With the implementation of the control measures outlined above the residual effect is considered to be - Negative, imperceptible, direct, low probability, permanent effect on peat and subsoils.

Significance of Effects: For the reasons outlined above, no significant impact on soils, mineral subsoils or bedrock are anticipated.

8.5.2 Likely Impacts and Mitigation Measures – Operational Stage

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

- Some construction traffic may be necessary for maintenance of turbines which could result in minor accidental leaks or spills of fuel/oil.
- The grid transformer in the substation and 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.
- There will be no direct impacts from the Grid Connection Route during the operational stage. The cable will be buried in ducting, within a backfilled trench along the public road, with no further works carried out during operation, aside from any emergency repair works which are highly unlikely.

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. Please note the on-site borrow pit will have been restored following the construction stage and will not be available to source aggregate during the operational phase.

No cumulative impacts on the soils and geology environment are envisaged during the operational stage.

Mitigation measures for soils and geology during the operational stage of the Proposed Development include the use of aggregate from authorised quarries for use in road and hardstand maintenance. 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/peat and subsoils and groundwater or surface water quality. The substation transformer and oil storage tanks will be in a concrete bunded capable of holding 110% of the oil in the transformer and storage tanks. Turbine transformers are located within the turbines, so any leaks would be contained. These mitigation measures are considered sufficient to reduce risk to ground/peat/soils and subsoils, and groundwater and surface water quality.

8.5.3 Likely Impacts and Mitigation Measures – Decommissioning Stage

The potential impacts associated with decommissioning will be similar to those associated with construction but of reduced magnitude, as it is envisaged that elements of the project, such as turbine bases will be rehabilitated rather than removed. This reduces the level of traffic and disruptive works within the Wind Farm Site. The cabling along the Grid Connection Route will also remain in place, which will significantly reduce the magnitude of decommissioning works on this part of the project, in comparison to the construction stage.

During decommissioning, it may be possible to reverse or at least reduce some of the potential impacts caused during construction by rehabilitating construction areas such as turbine bases, hardstanding areas, the substation and site compounds. This will be done by covering with peatland vegetation/scraw or poorly humified peat to encourage vegetation growth and reduce run-off and sedimentation. The grid connection cabling will be left in-situ, as it is considered best environmental practise to do so, rather than re-excavating the trenching. Other impacts such as possible soil compaction and contamination by fuel leaks will remain but will be of reduced magnitude. However, as noted in the Scottish Natural Heritage guidance on restoration and decommissioning of onshore wind farms (SNH, 2013) reinstatement proposals for a wind farm are made approximately 30 years in advance, so within the lifespan of the wind farm, technological advances and preferred approaches to reinstatement are likely to change. It is therefore 'best practice not to limit options too far in advance of actual decommissioning but to maintain informed flexibility until close to the end-of-life of the wind farm'.

A decommissioning plan is contained in Appendix 4-11 of this EIAR for the decommissioning of the Proposed Development, the detail of which will be agreed with the local authority prior to any decommissioning. The potential for effects during the decommissioning phase of the Proposed Development has been fully assessed in the EIAR.

Mitigation measures applied during decommissioning activities will be similar to those applied during construction where relevant. Some of the impacts associated with reinstatement of the site (excavation of turbine bases, access tracks etc.) will be avoided by leaving these in place. The bases will be rehabilitated by covering with local topsoil/peat in order to regenerate vegetation which will reduce runoff and sedimentation effects. Access tracks which are not required for farm use will also be covered with topsoil/peat and rehabilitated in a similar manner. 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 in Section 8.5.1.

No significant cumulative impacts on the soils and geology environment are envisaged during the decommissioning stage.

8.5.4 Assessment of Health Effects

Potential health effects arise mainly through the potential for soil and ground contamination. A wind farm/grid connection route is not a recognized source of pollution and so the potential for effects during the operational phase are negligible. 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 negligible.

8.5.5 Cumulative Effects

Due to the localised nature of the proposed construction works which will largely be kept within the Wind Farm Site/Grid Connection Route (aside from minor junction improvement works and ancillary works), there is no potential for significant cumulative effects in-combination with other local developments on the land, soils and geology environment outside of the proposed Wind Farm Site and Grid Connection Route boundaries.

Both the Wind Farm Site and Grid Connection Route are located in the River Shannon catchment. However, in terms of soils and geology cumulative impacts arising from the Wind Farm Site infrastructure and the Grid Connection Route, none are anticipated as the Grid Connection Route is along the carriageway of public roads and is generally remote from the Wind Farm Site. Subsoil excavated along the Grid Connection Route will where possible be reinstated back within the trench.

Turbine delivery route works are required at 11 no. locations, however all proposed road works are small scale and localised and cumulative effects are not anticipated.

In relation to non-wind farm developments, the majority of local developments relate to the provision and/or alteration of one-off housing and agricultural developments. Applications which are not of an individual domestic or agricultural nature in the vicinity of the EIAR study area are listed in Chapter 2.

The majority of local non-wind developments in the vicinity of the proposed wind farm study area are small scale, localized or linear, and are temporary in nature.

As a result, impacts on soils and geology are not expected due to separation distances and the temporary and dispersed nature of the works. Therefore, soils and geology cumulative impacts with respect to the Proposed Development are also not expected.

8.5.5.1 Nearby Wind Energy Developments

Nearby wind energy developments which have been included in the cumulative assessment are listed below in Table 8-12.

Table 8-12: Nearby Wind Energy Developments (within 20km)

Wind Energy Development	No. of Turbines	Proposed/Existing	Distance to Coole WF Site
Ballyjamesduff Wind Farm	1	Existing	~17km
Ballyjamesduff Wind Farm	1	Proposed	~17km

8.5.5.2 Nearby Non Wind Energy Developments

There were no nearby non-wind energy developments identified during the assessment.