9 LAND AND SOIL

9.1 INTRODUCTION

This chapter assesses the impact to the land and soils environment and considers any direct and indirect effects on these natural resources arising from the proposed project including the Drumnahough Wind Farm development, associated infrastructure, the alternative grid connection option and replacement forestry lands as detailed in Chapter 2. The baseline conditions at the site are presented and the potential effects anticipated from the proposed development are discussed. Mitigation measures are suggested where appropriate and any residual impacts are assessed.

9.1.1 Scope of assessment

The chapter includes data and descriptions of the soil and subsoil at the site as well as any prominent geological features. Data includes information from site visits as well as desktop research. The geology is described at the local and regional level. All activities associated with the project are considered for the construction, operation and decommissioning phase impacts. Cumulative impacts have also been considered. The assessment was completed having regard to the *Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports.* Environmental Protection Agency (2017).

9.1.2 Methodology

A desk study was first undertaken to collate and review available information, datasets and documentation sources pertaining to the Drumnahough site's natural environment. The desk study involved the following:

- Examination of maps and aerial photography;
- Examination of the Geological Survey of Ireland (GSI) datasets pertaining to geological issues (bedrock, heritage, subsoil) and extractive industry data;
- Examination of Geohive/ EPA / Teagasc online soil and subsoil maps;
- Preparation of site maps.

Field surveys were undertaken between September 2019 and February 2020 and comprised the following:

- A walkover survey of the site to identify geological and soil features, geomorphological features, relict failures, rock exposures, wet ground, general soil and rock types and drainage patterns.
- The walkover included the measurement of slope inclination and mapping of prominent features.
- Identification, if present, of any water and drainage features on site and existing drainage patterns.
- The survey also determined the presence, extent and depth of any peat. Gouge coring was carried out to ascertain soil depths and hand shear vane tests were carried out to obtain shear strength parameters. The results of the peat assessment are presented in the Peat Stability Risk Assessment Report (refer to EIAR Volume 3 – Appendix E-1).
- The initial site reconnaissance survey completed by MWP for this report was carried out in June 2019. Further site investigations and site visits were carried as part of the iterative design process on the dates detailed in **Table 9-1**

Table 9-1 List of Site Visits

Names	Date	Purpose
Cormac Murphy	27th June 2019	Initial site reconnaissance to inform initial site layout
Eoin Doyle and Fergus Doyle	19th September 2019	Peat probing at locations of the proposed infrastructure.
Paddy Curran	17th December 2019	Site reconnaissance to further refine layout and view proposed borrow pit locations
Eoin Doyle and Paddy Curran	21st January 2020	Review of options for proposed access road from T7 through to T12. Further peat probing conducted in this area.
Eoin Doyle and Cormac Sheehy	29th January 2020	Review of location of proposed substation and battery storage facility. Further peat probing conducted in this area.

9.1.3 Assessment Criteria

The assessment is based on the EPA Glossary of Effects, included in the draft revised Guidelines on Information to be contained in Environmental Impact Assessment Reports (2017). The assessment of the Likely Significant Impacts using the methodology set out in the Institute of Geologists of Ireland Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapter of Environmental Impact Statements (2013) was also consulted.

9.2 EXISTING RECEIVING ENVIRONMENT

9.2.1 Location of the Proposed Development Site

The proposed development is a twelve (12) No. wind turbine project. The proposed development is located in a rural upland area of central Donegal on the southern and western slopes of Cronaglack, Crockalogh and Cark, approximately 12.5km south west of Letterkenny and 11km northwest of the twin towns of Ballybofey/Stranorlar. The site boundary encompasses the townlands of Tooslenagh, Treankeel, Meenadaura, Carrickalangan, Culliagh, Cark, Killymasny, Meentycat, Meenalabbin and Aughkeely, in Co. Donegal.

9.2.2 Site Topography

The site elevation ranges from 330m, between T8 and T9, and 235m elevation west of T1. Cark Mountain (elevation 364m AOD) is located to the east of T3. The wind farm access tracks are generally located in areas where the contours are widely spaced with the exception of the areas to the northern end of the site.

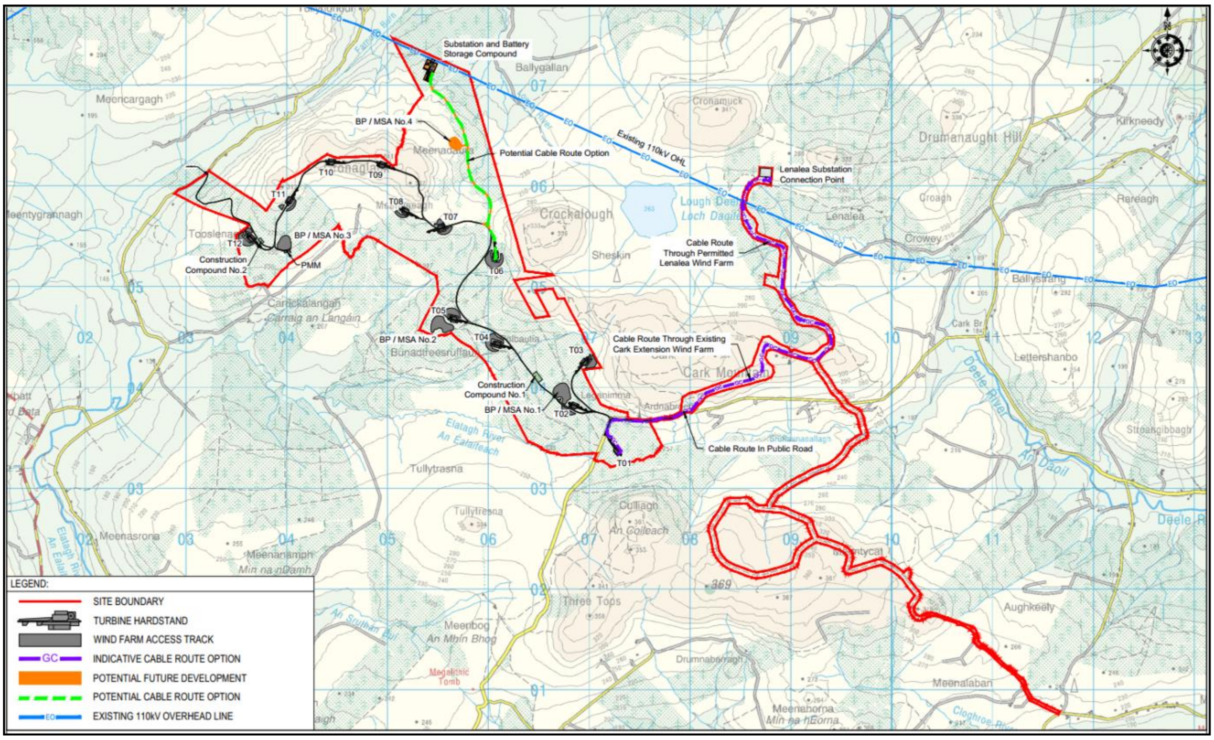

Figure 9-1: Proposed Site Layout

9.2.3 Land Use

The mapped land use of the site is shown in **Figure 9-2**. This mapping was created using information from CORINE Land Cover 2018 available on the EPA online mapping system. The following land uses have been identified at the site:

- Transitional Woodland Scrub
- Land principally occupied by agriculture with significant areas of natural vegetation
- Peat Bogs
- Coniferous Forests

T3, T7 to T12 and the Permanent Met Mast are located in areas mapped as *Peat Bogs*. T2 and T6 are located in mapped areas of *Transitional Woodland Scrub*. T5 is located in an area of *Coniferous Forests*. T4 is located at an interface area of *Coniferous Forests* and *Transitional Woodland Scrub*. T1 is located within *Land Principally Occupied by Agriculture with Significant Areas of Natural Vegetation*. The proposed access tracks and cable routes traverse areas of *Peat Bogs, Land Principally Occupied by Agriculture with Significant Areas of Natural Vegetation* and *Coniferous Forests*.

The majority of the project site is located within Coillte owned afforested land which has been certified to the Forest Stewardship Council (FSC) forest management standard. This certification assures that they are well managed in accordance with strict environmental, social and economic criteria. These standards have been applied in the approach to this project development and design. Coillte must adhere to strict environmental conditions in order to maintain its FSC certification. Any felling to facilitate the turbine construction and operation will be undertaken by a suitably experienced and qualified felling company. Felling will be carried out within the safeguards set out in the Forestry Service

Guidelines, albeit forestry felled for wind energy projects is excluded from FSC certification if carried out during the construction phase.

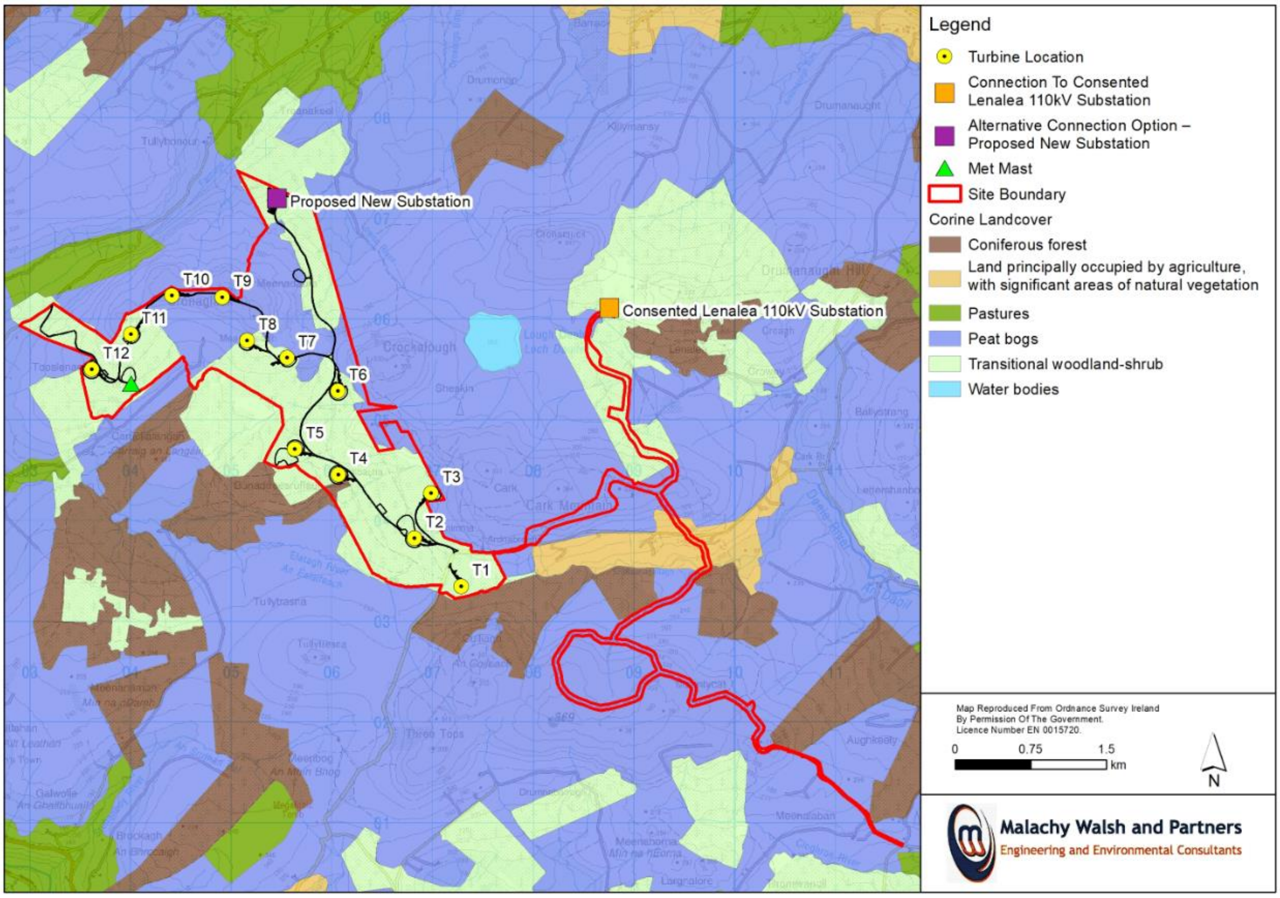

Figure 9-2: Land Cover (CORINE)

9.2.4 Regional Geology

Donegal County Council's current County Development Plan describes the county's key geological feature as the Gweebarra fault that continues under the Atlantic and also forms another diagonal rift through the Scottish Highlands and which was formed through granite rock by glacial erosion. Igneous rock is the predominant rock type in Donegal with glass-like quartz, feldspars and black mica evidenced in the granite. The County also includes large areas of metamorphic rocks including schists and gneisses and quartzite as evidenced on Errigal Mountain.

The geology of Co. Donegal contains the oldest rocks in Ireland, around 1780 million years old. 1000 million years ago (Ma) sediments were deposited in an ocean and an Ice Age at this time produced glacial till of cobbles of rock set in a matrix of crushed rock. In 700Ma the whole area was subjected to an episode of mountain building called the Grenvillian Orogeny and the rocks were metamorphosed or altered into gneiss, schists and quartzites, which are now known as the Dalradian Group. Errigal Mountain is composed of this quartzite which weathers to a 'sugarloaf' shape. The metamorphosed glacial deposits are called Tillites. During a later orogeny called the Caledonian, two continents collided and the north-east to south-west trend of the rocks in Donegal was produced. Around 405Ma, a series of six granite masses were injected into the older rocks, of which the Main Donegal Granite is the largest. In the Lower Carboniferous (350Ma) a warm shallow ocean migrated northwards very slowly. When it reached Donegal it resulted, firstly, in the deposition of sands and muds, carried south by rivers that drained the old continent. This material was laid down close to the shoreline which now forms the sandstones and mudstones at Doorin Point. These gave way to limestones that often contain corals and other fossils. The sea level fluctuated at this time and a shallowing of the sea, saw further sandstones (such as the Mountcharles Sandstone) being deposited. Later limestone was deposited in the deepening ocean. The Carboniferous rocks are found in a semicircle around Donegal Bay. (County Geology of Ireland: Donegal, 2009)

9.2.5 Local Geology

The site itself is underlain by Schist of Termon Formation. There is Upper Crana Quartize present along the site boundary to the north east of T12. Lough Eske Psammite Formation consisting of psammite, quartize and marble is present in the location of T1. The site generally reflects the geology discussed within the previous section. (Geological Survey of Ireland, Online Maps 2020)

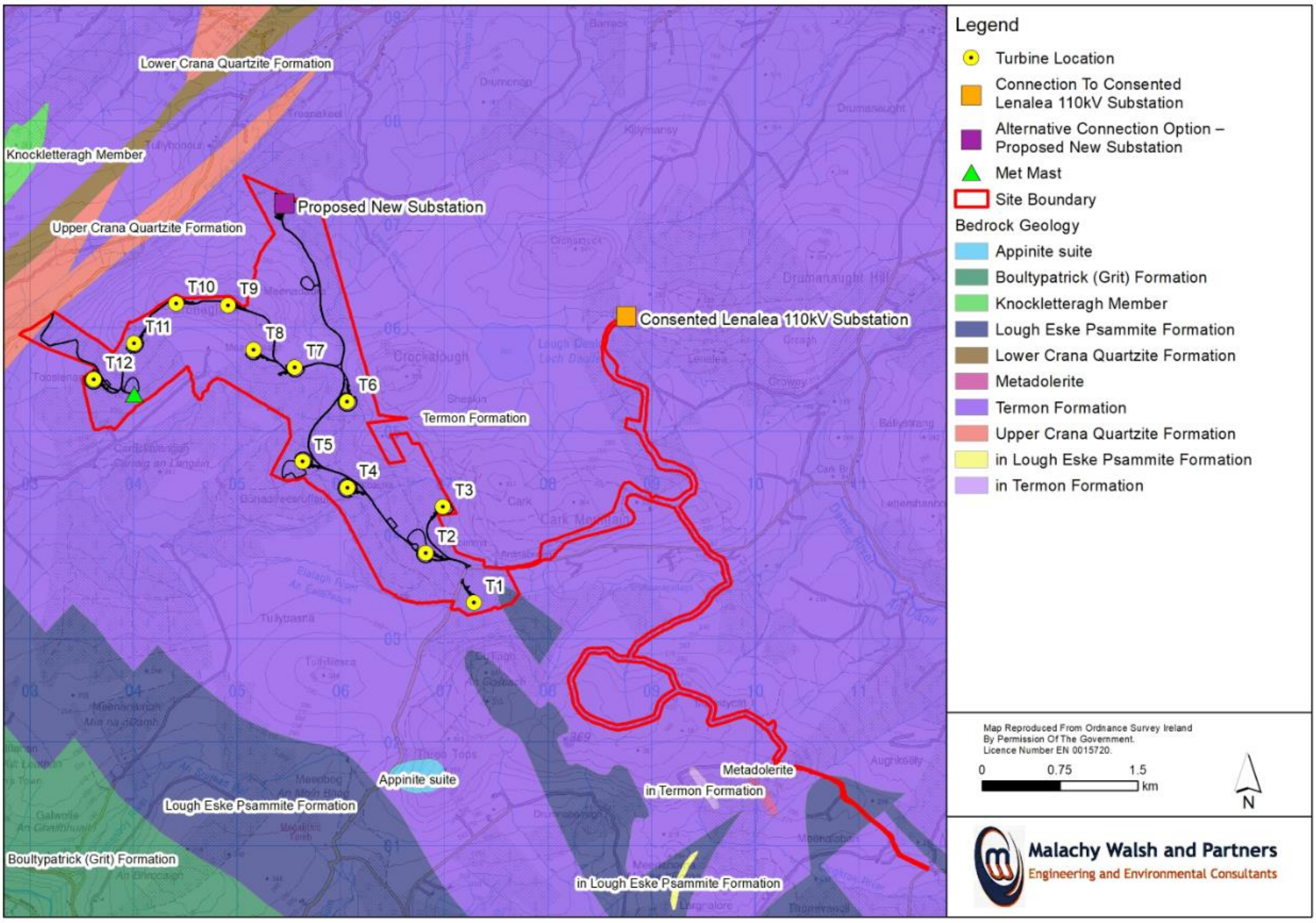

Figure 9-3: Bedrock Description

9.2.6 Soil and Subsoil

Soil includes the topsoil (soil) and subsoil, which together provide for the following important functions;

- Facilitate the hydrological cycle in the filtration/recharge, storage and discharge of rainwater
- Support all terrestrial ecology, including all flora and fauna (and all food crops)
- Protect and enhance biodiversity
- Holding or preserving archaeological remains
- Provision of raw materials and a base on which to build

Soil (topsoil) and subsoil may derive from parent geological material and organic matter under the influence of processes including weathering and erosion.

The predominant soil type present at this site is “*Blanket Peat*” according to the Teagasc/ EPA Soil Maps available on the Geological Survey of Ireland online mapping system, refer to **Figure 9-4.** Areas of “*Peaty Podzols*” are present in the northern half of the site. Pockets of “*Surface water Gleys/ Ground water Gleys Acidic*” are present to the north and south of the site. The characteristics of the *Blanket Peat* soil type based on data from Teagasc are a high level of organic matter and very high moisture content.

The Quaternary Sediments at the site shown on the Geological Survey of Ireland online mapping system include “*Blanket Peat*” for the majority of the site with local concentrations of “*Bedrock at surface*” and “*Metamorphic Till*” present mainly in the northern half of the site. **See Figure 9-5** for further information.

The field survey undertaken in late 2019 and early 2020 verified the published literature on soil and subsoil at the site in that the dominant spatial coverage soil unit is Peat overlaying Schist Bedrock. The peat stability within the proposed wind farm site is fully assessed in the Peat Stability Risk Assessment Report (refer to EIAR Volume 3 – Appendix E-1).

A number of photographs of the peat and bedrock taken during site walkovers at Drumnahough are shown in **Plate 9-1**.

Land use practice has much altered the natural soil environment at the site over time through disturbance for afforestation and improvement for agricultural purposes.

Plate 9-1 Photographs of Soils and Bedrock at the Site

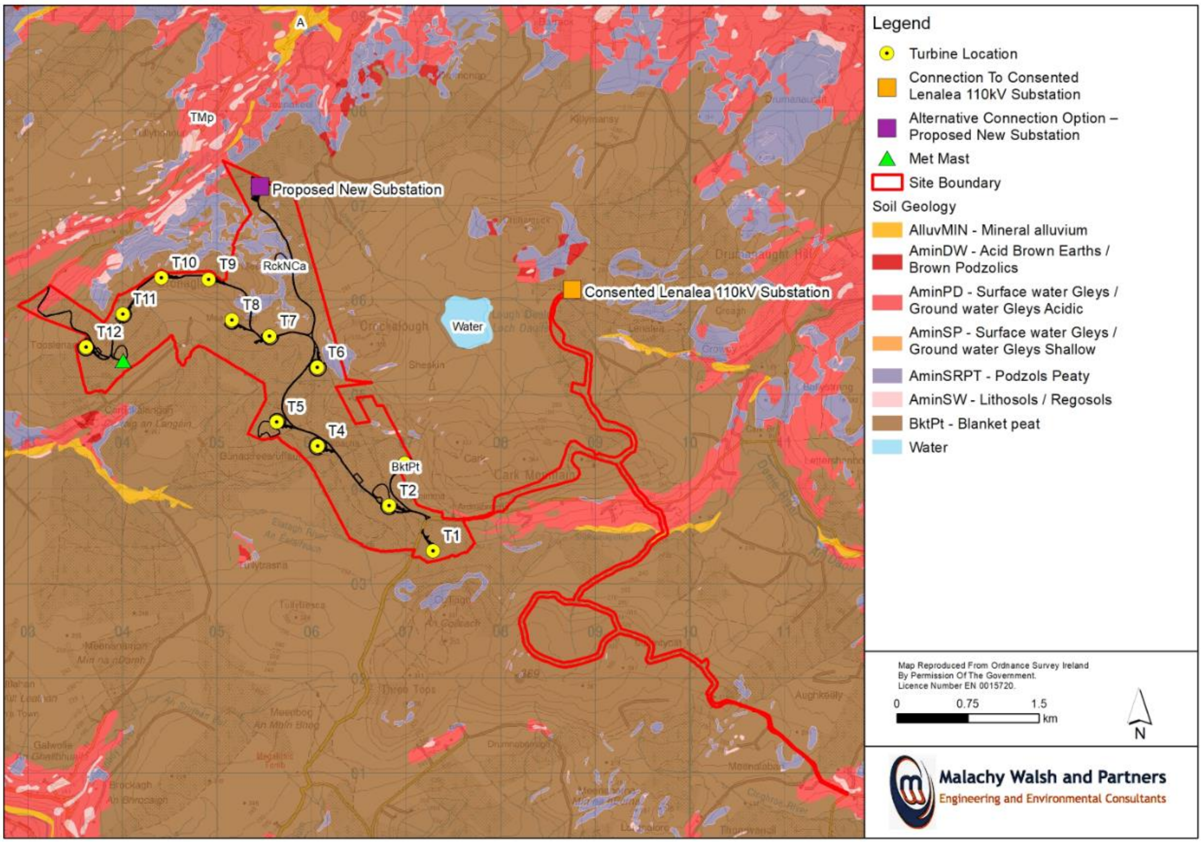

Figure 9-4: Soil Descriptions

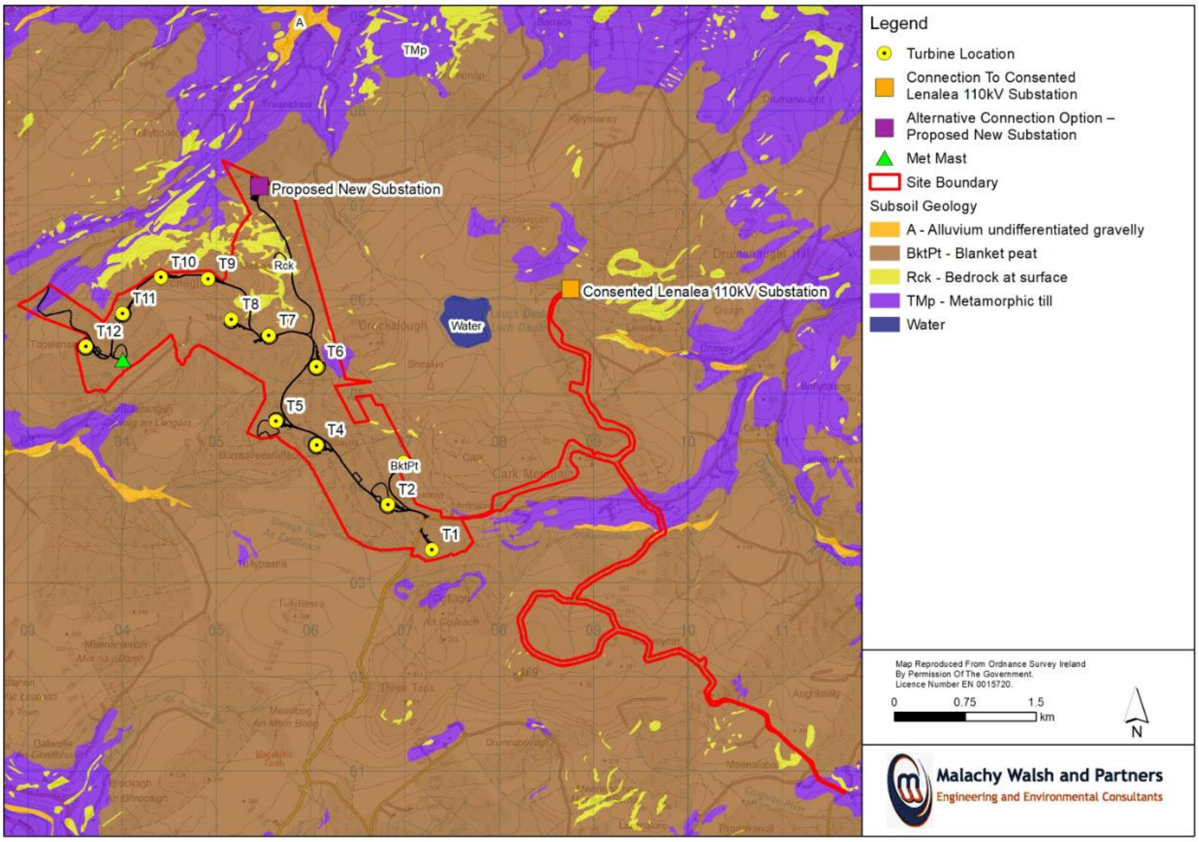

Figure 9-5: Subsoils

9.2.7 Geological Heritage

The Irish Geological Heritage (IGH) Programme identifies and selects a complete range of sites that represent Ireland's geological heritage under a variety of themes ranging from Karst features to Hydrogeology. The IGH Programme is a partnership between the GSI and the National Parks and Wildlife Service (NPWS) and sites identified as important for conservation are conserved as Natural Heritage Areas (NHA). Review of the GSI Geological Heritage Database available on the GSI online mapping system indicates that there are no Geological Heritage Sites within the site. The nearest mapped Geological Heritage Sites are listed below in **Table 9-2.** Note that the audit of Geological Heritage Sites within Donegal is advised as being "in preparation" by the GSI on their website, therefore the sites summarised in the table are unaudited.

Table 9-2: Unaudited Geological Heritage Sites within 10km of Site

Reference Number	Site Name	Description
A	River Finn	None given
B	Clogheracullion	Uraninite in bog
C	Glenaboghill	Veins in Dalradian calcareous schists, marble and quartzite. Mined in the early 1800s

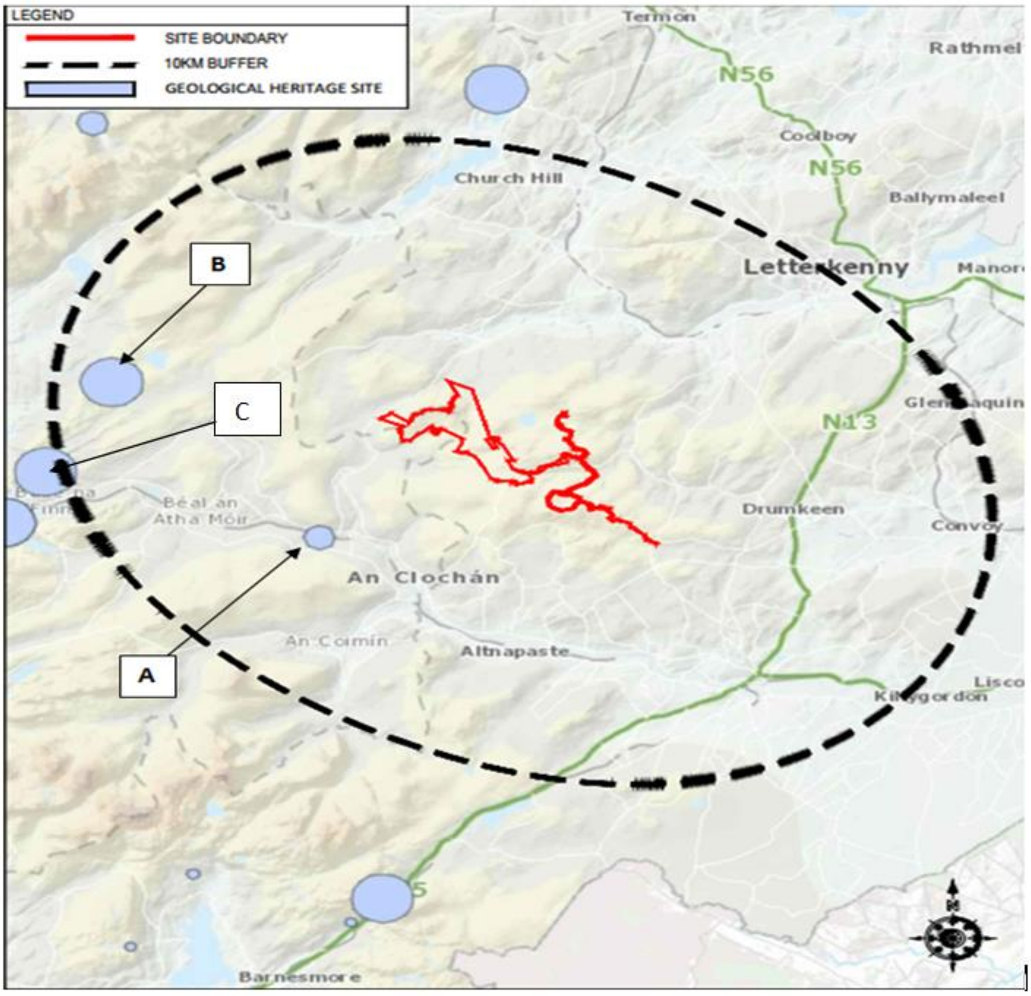

Figure 9-6: Unaudited Geological Heritage Sites within 10km of Site

9.2.8 Economic Geology

There are a number of active and inactive quarries operating in the North Western Region of Ireland and Northern Ireland. The GSI records for Active Quarries operating in the area are shown on **Figure 9-7.**

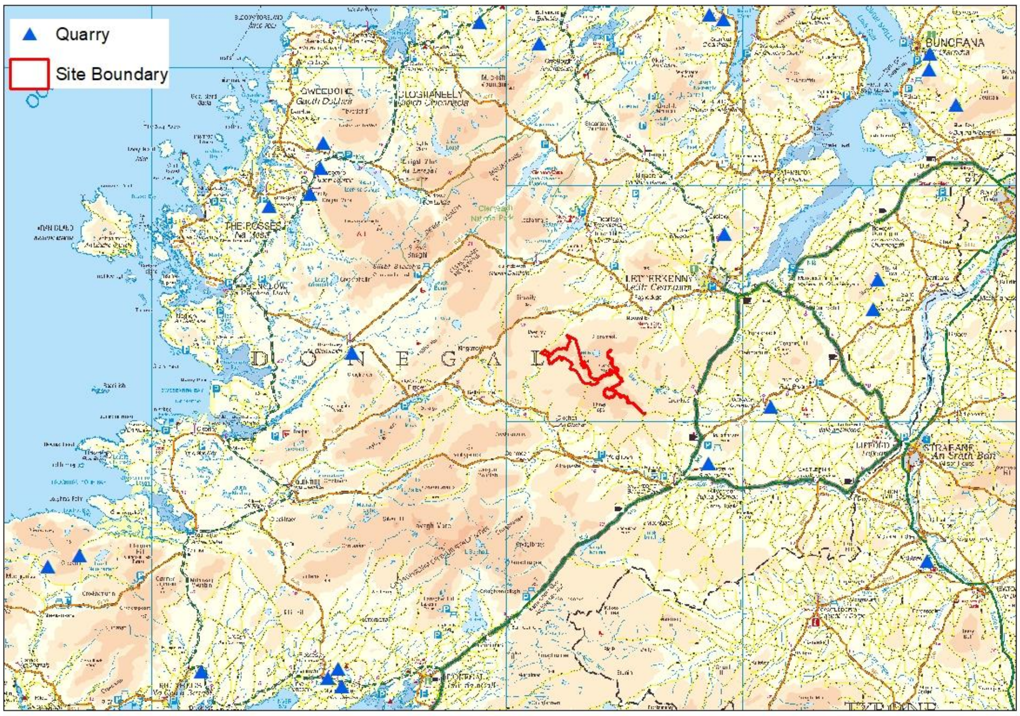

Figure 9-7: Active Quarries (from GSI Online Mapping)

Recorded mineral locations have the potential to be used for future mineral extraction. According to the GSI, there are a number of recorded metallic mineral locations in the area (Refer to **Figure 9-8**). None of these locations are within the site. The closest is approximately 2km from the site therefore the development of this site will not impact on any potential future mineral extraction location.

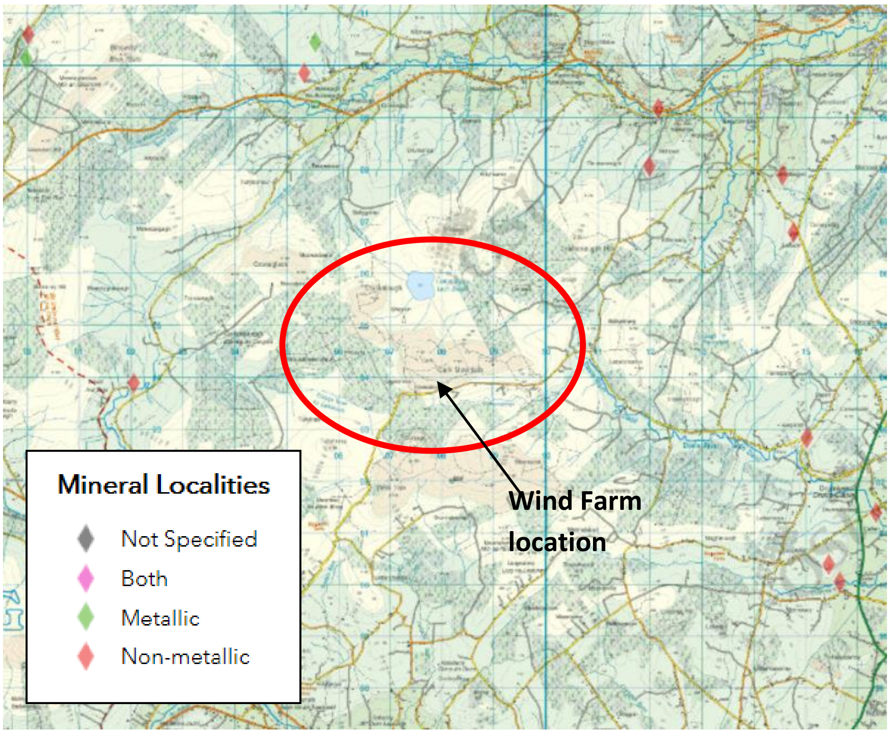

Figure 9-8: Mineral Localities in proximity of the site (Source GSI)

9.2.9 Peat Depth and Stability

MWP completed extensive peat probing and hand shear vane testing of the study area over the course of 6 months from September 2019 to January 2020.

In total 560 peat probes were taken across the study area. The maximum peat depth encountered was 4.5m deep, the minimum depth of peaty cover was 0.1m. The average depth for the data set across the study area was 1.73m.

Shear values were collected at 292 probe locations using a hand shear vane with results which range from 7kPa to 49kPa across the site.

Peat stability at the site has been assessed in the Peat Stability Risk Assessment Report which is included in Appendix E-1 Volume 3 of the EIAR. The report includes information from desk study, site reconnaissance, peat probing and peat stability assessment. It has been completed in line with the recommendations of the Energy Consents Unit Scottish Government, Peat Landslide Hazard and Risk Assessment: Best Practice Guide for Proposed Electricity Generation Developments.

The conclusion of the Peat Stability Risk Assessment Report is summarised below:

The study used a two-stage approach to peat stability risk assessment that combined desk study, site reconnaissance, qualitative and quantitative analysis to identify the level of risk from peat landslide for the proposed wind farm site.

MWP employed the Peat Slide Hazard Rating System for Wind Farm Development Purposes (Nichol, 2006) to assess the hazard ranking of the study area. The output of this method of analysis was that the area represented a ***Low to Low-Moderate Hazard Rating*** *for peat slide. The findings reflect the mitigation by design philosophy adopted in designing the wind farm infrastructure of avoiding areas of steeper slopes from the outset.*

The engineering response for a ***Low*** *rating in the Nichol (2006) PHRS is that further investigation of the peat slide hazard may be required. The recommended engineering response to a finding of a* ***Low-Moderate*** *is Peat-slide stabilisation works may be required. This is typically in the form of a granular berm on the downslope side of the infrastructure to prevent peat movement.*

MWP progressed to a risk assessment carried out in accordance with the guidance of the Scottish Government PLHRA (2nd Ed 2017). This Included infinite slope analysis and risk assessment. The output of the Peat Landslide Hazard Risk Assessment was that peat landslide presented a ***Negligible Risk*** *to the infrastructure of the Wind Farm and surrounding area.*

9.2.10 Soils and Bedrock at Replacement Forestry Lands

Forestry will be removed within the Drumnahough site as part of the development of the proposed wind farm. Replacement lands are proposed to be planted with forestry as required for the tree felling licence. These lands are situated in Counties Clare, Cork, Limerick and Galway (**See Figure 9-9**). The soils and bedrock at each of these sites is discussed in the following sections of this report.

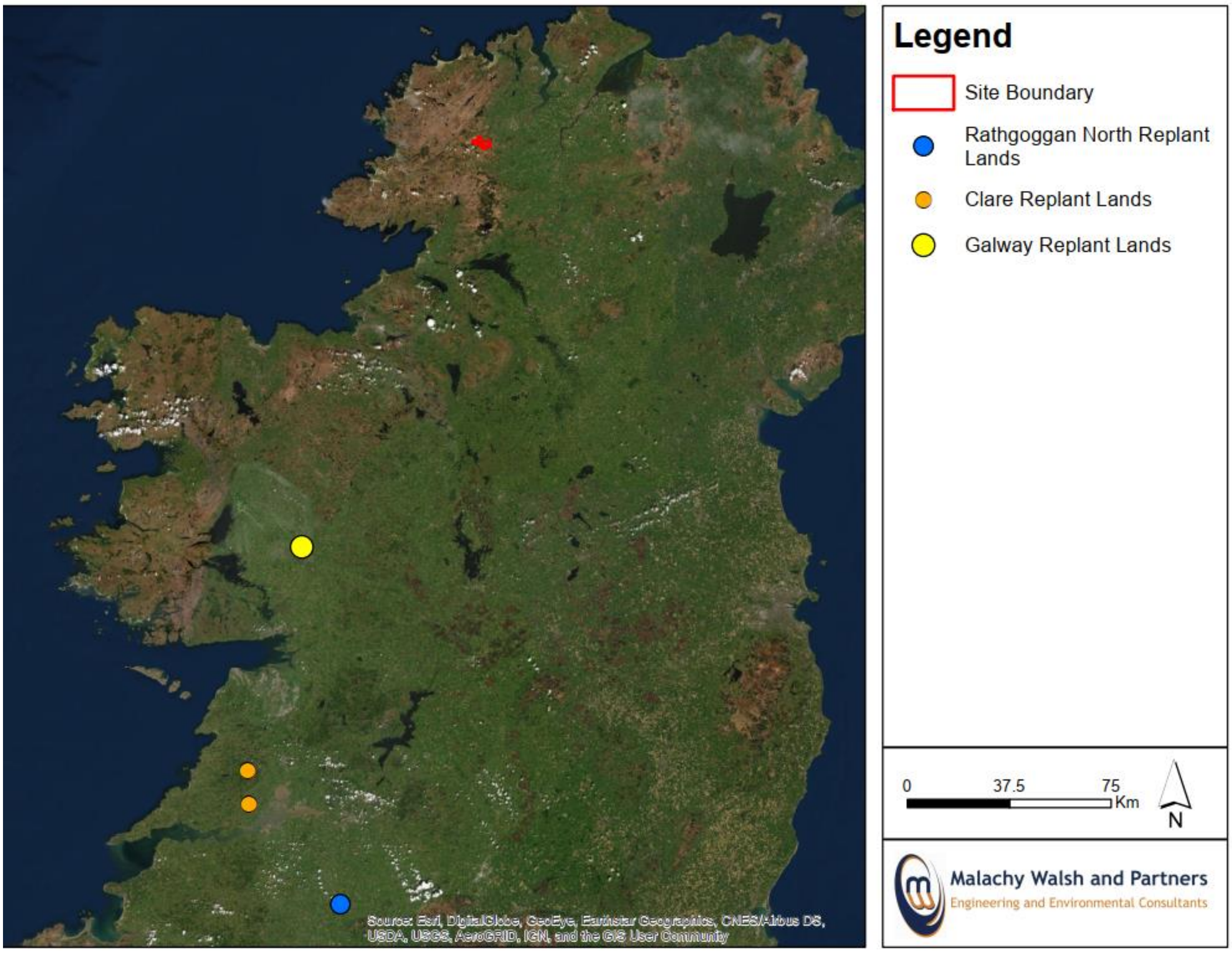

Figure 9-9: Replacement Forestry Sites

9.2.10.1 Replacement Lands in County Clare

Central Clare Group Formation underlies both sites in County Clare as shown in **Figure 9-10** and **Figure 9-11.** This is comprised of five cyclotherms which appear to be in the following sequence; mudstone followed by siltstone and then sandstone.

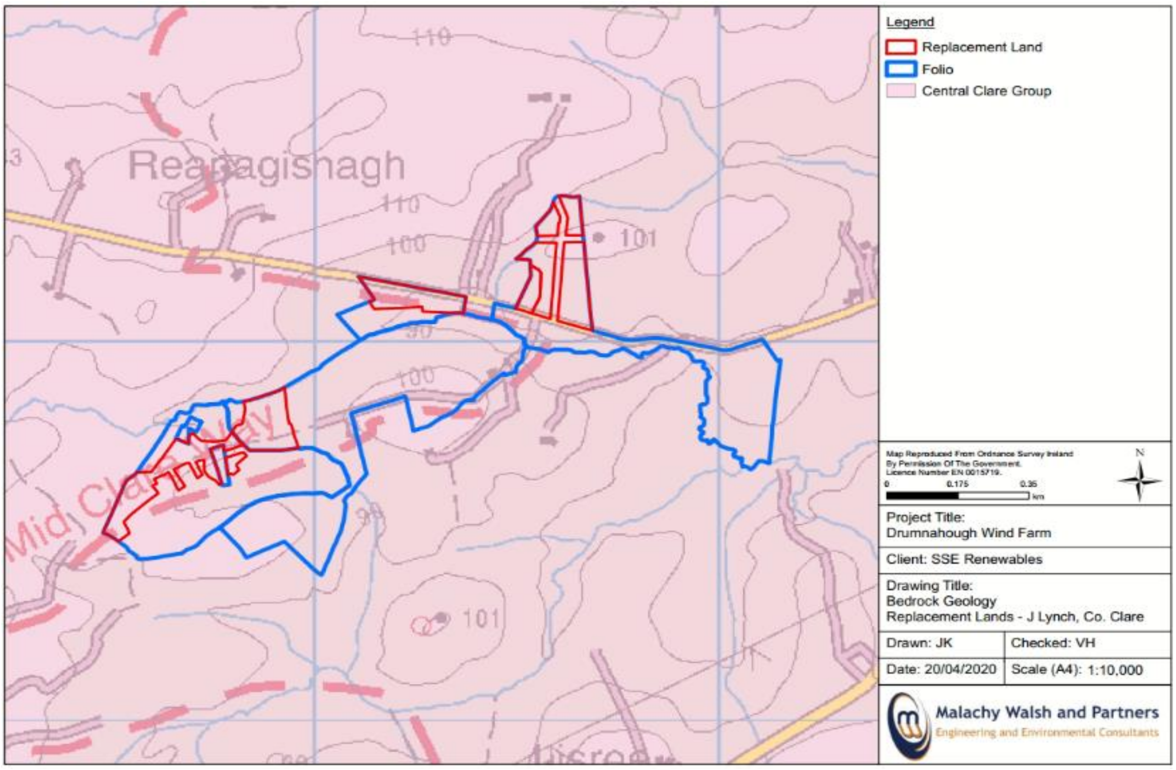

Figure 9-10: Bedrock Geology –Replacement Lands at Furroor, Lisroe, Reanagishagh and Kilcolumb, Co. Clare

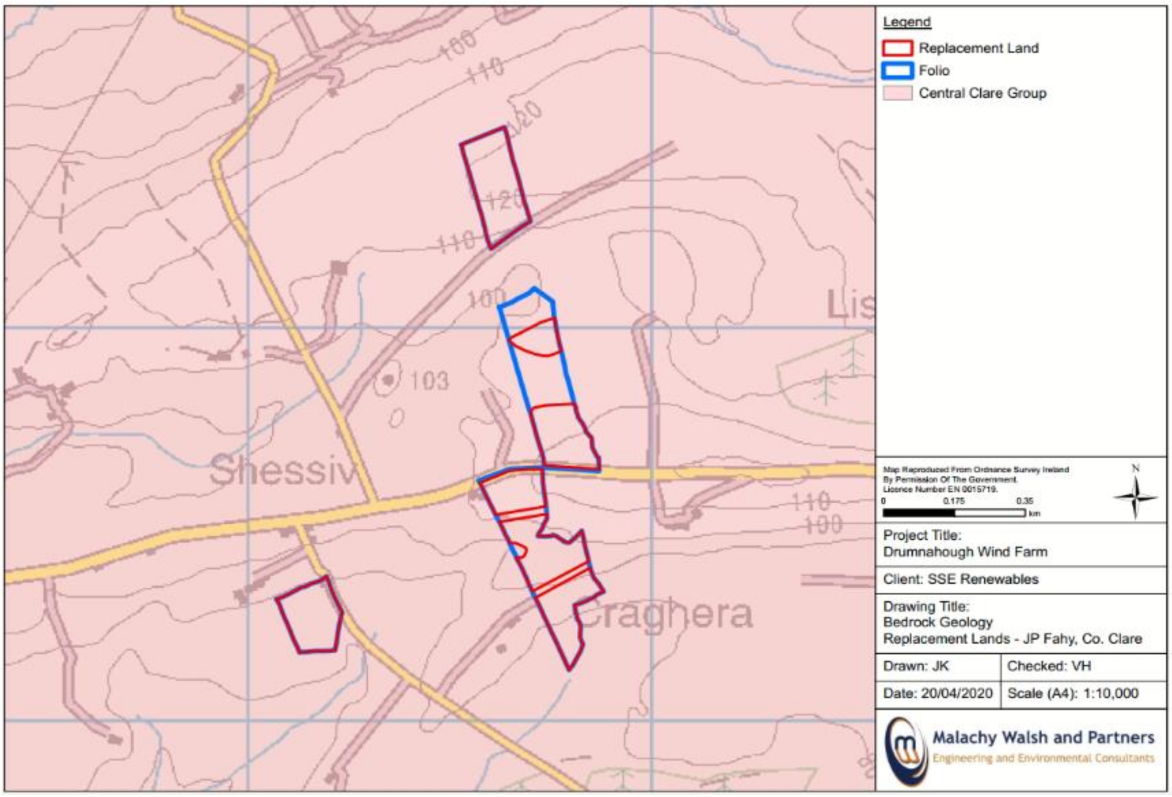

Figure 9-11: Bedrock Geology - Replacement Lands at Shessiv and Craghera, Co. Clare –

The majority of the site in **Figure 9-12** has "Blanket Peat" as it's subsoil. The remaining subsoil on this site is "Tills derived from Shales and Sandstones," "Bedrock at surface" and "Cutover Peat." The majority of subsoil underlying the site in **Figure 9-13** is also "Blanket Peat." A portion to the south is "Bedrock at Surface." A minority of this site's subsoils are "Cutover Peat" and "Tills derived from Shales and Sandstones."

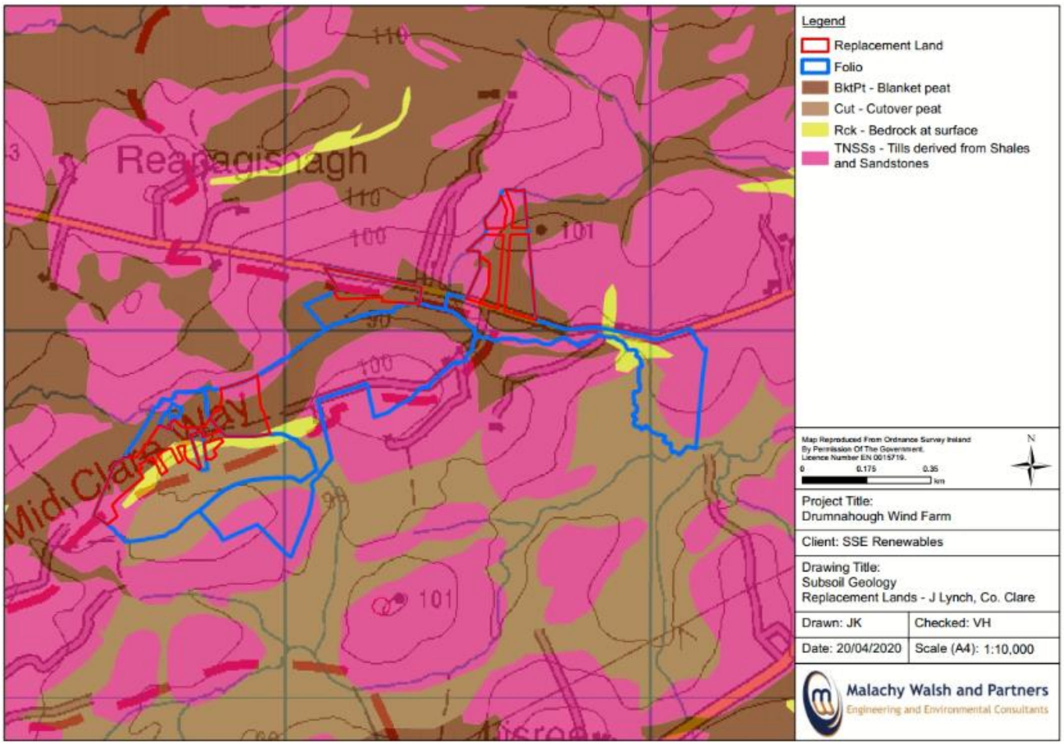

Figure 9-12: Subsoil Geology - Replacement Lands at Furroor, Lisroe, Reanagishagh and Kilcolumb, Co. Clare

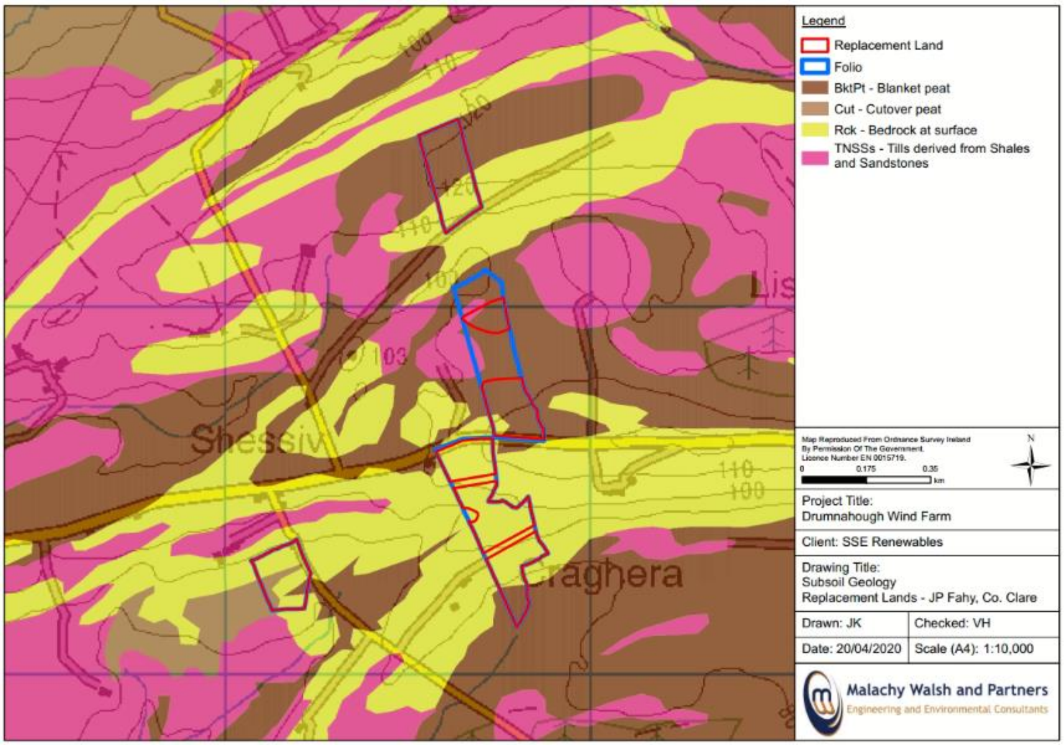

Figure 9-13: Subsoil Geology – Replacement Lands at Shessiv and Craghera, Co. Clare

The majority of the soil on the site is "Blanket Peat." "Surface water Gleys/ Ground Water Gleys Acidic" are present to the north of this site. "Peaty Gleys Acidic," "Surface water Gleys/ Ground water Gleys

Shallow" and "Podzols Peaty" are also present in this site. The other site of replacement lands in Clare in **Figure 9-15** has "Lithosols/ Regosois" as the majority of soil in the southern half whereas the northern half is predominately "Blanket Peat." Soils also present on this site include; "Podzols Peaty," "Raised Bog cutaway/cutover" and "Peaty Gleys Acidic."

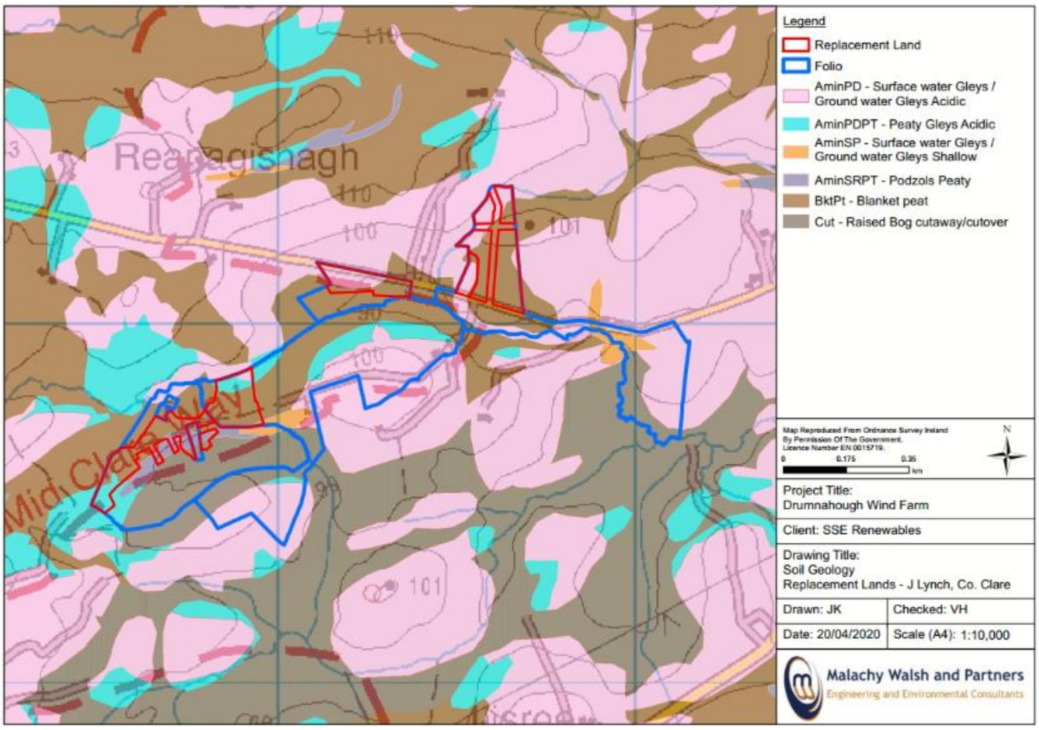

Figure 9-14: Soil Geology - Replacement Lands at Furroor, Lisroe, Reanagishagh and Kilcolumb, Co. Clare

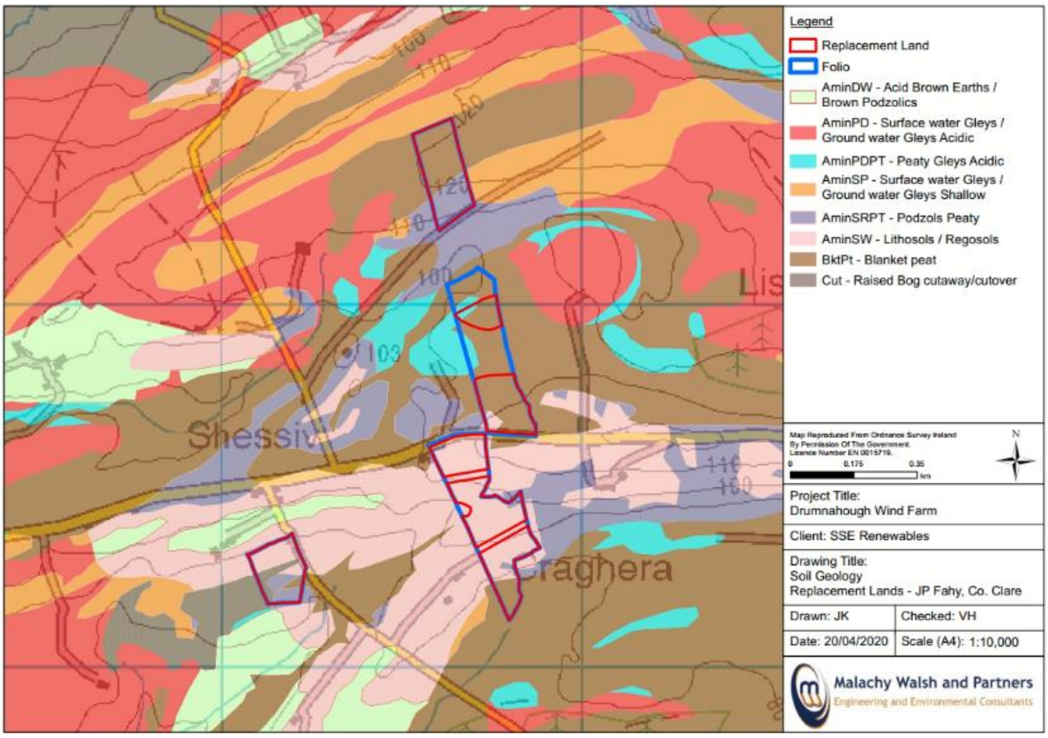

Figure 9-15: Soil Geology - Replacement Lands at Shessiv and Craghera, Co. Clare

9.2.10.2 Replacement Lands in Counties Cork and Limerick

The sites in Cork and Limerick are underlain by undifferentiated Visean Limestones as shown in **Figure 9-16.**

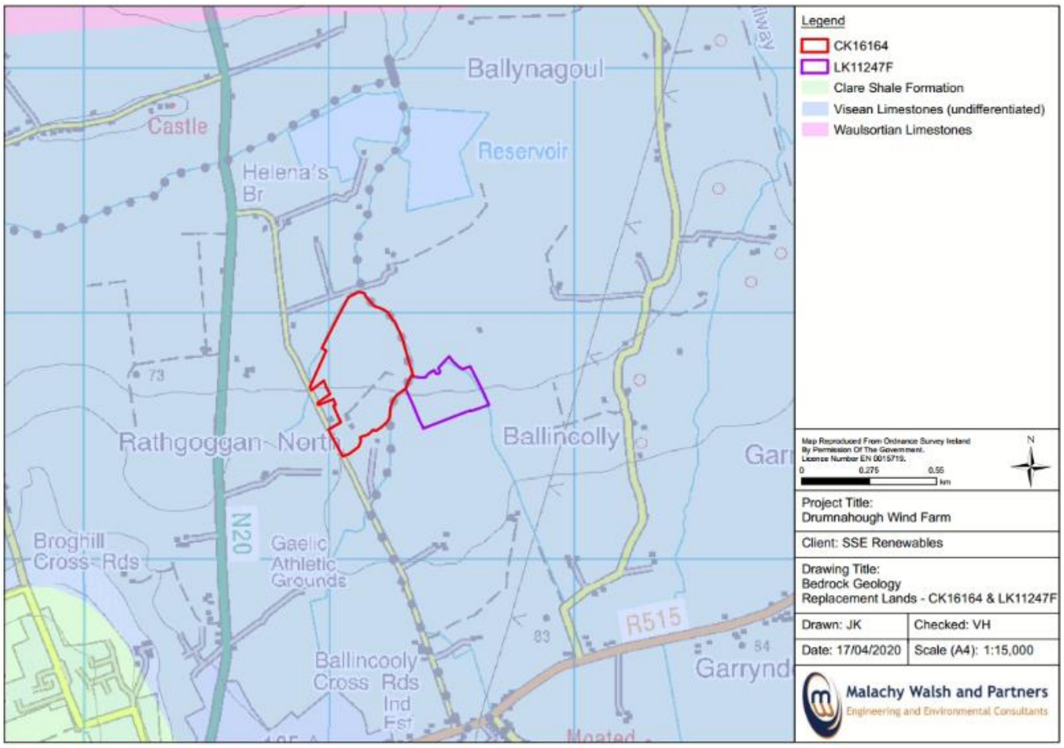

Figure 9-16: Bedrock Geology – Replacement Lands Rathgoggan North, Ballincolly, Co. Cork/Limerick

The subsoil for both sites, as presented in **Figure 9-17**, is mapped as "Bedrock at surface".

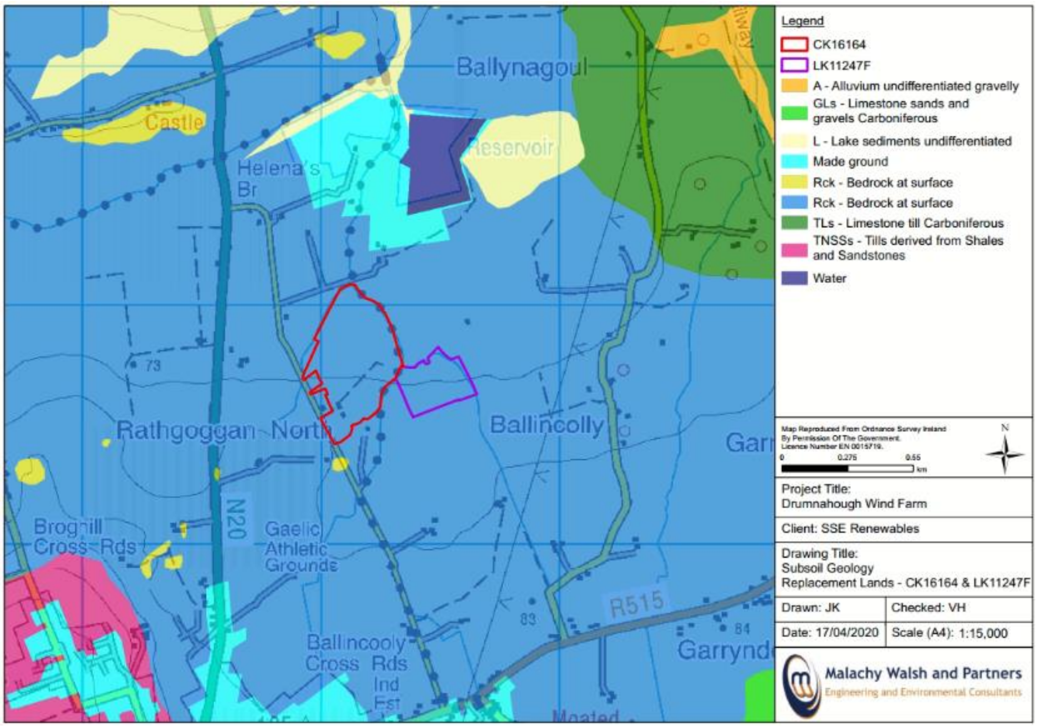

Figure 9-17: Subsoil Geology – Replacement Lands Rathgoggan North, Ballincolly, Co. Cork/Limerick

The majority of the soil in the Cork site is "Surface Water Gleys/ Ground Water Gleys Acidic" with a portion to the south being "Acid Brown Earths/ Brown Podzolics." The majority of the Limerick site is "Acid Brown Earths/ Brown Podzolics" with a portion of the north west corner being "Surface Water Gleys/ Ground Water Gleys Acidic" as can be seen in **Figure 9-18.**

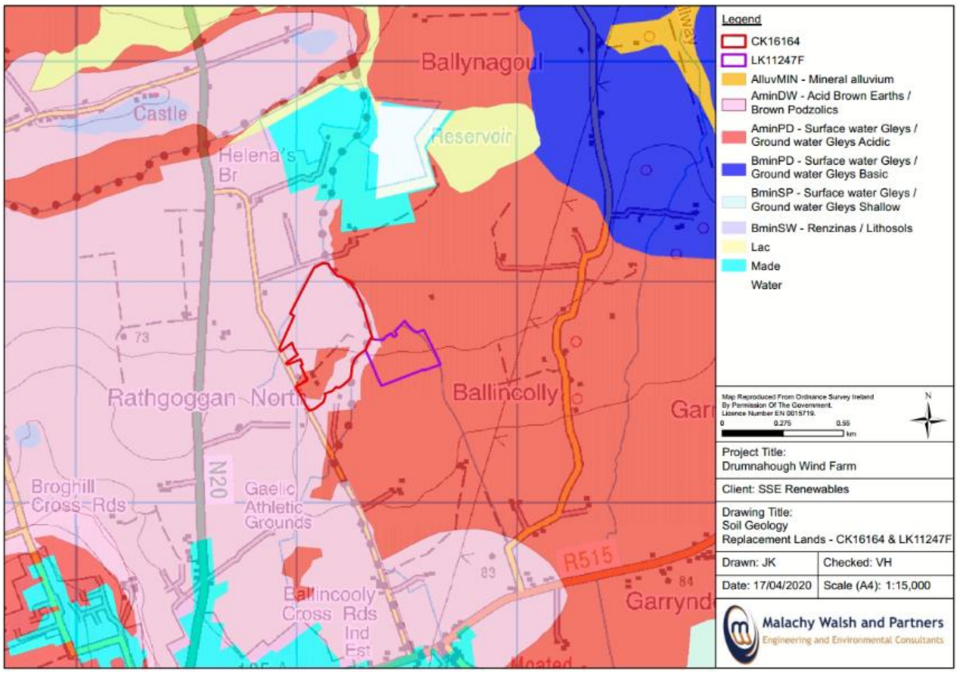

Figure 9-18: Soil Geology – Replacement Lands Rathgoggan North, Ballincolly, Co. Cork/Limerick

9.2.10.3 Replacement Lands in County Galway

The bedrock which underlies the site in County Galway is of "Croghan Limestone Formation" as presented in **Figure 9-19**. This is comprised of a thin bedded brown-weathering muddy limestone.

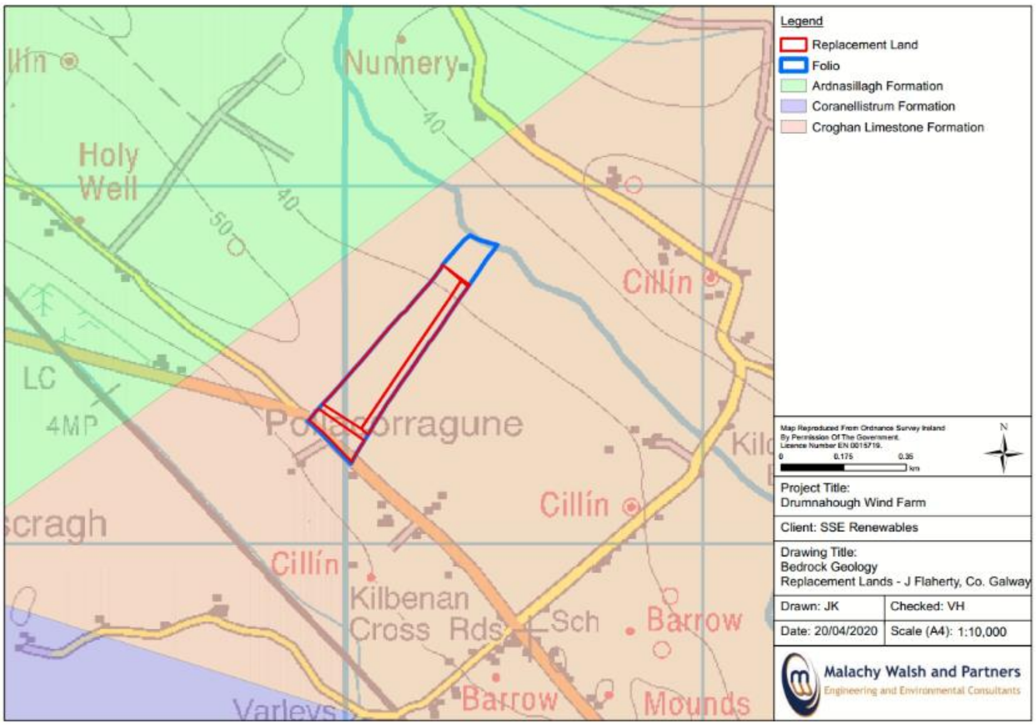

Figure 9-19: Bedrock Geology - Replacement Lands at Pollacurragune, Co. Galway

"Limestone Till Carboniferous" is the subsoil which underlies the site in County Galway as shown in Figure **9-20**.

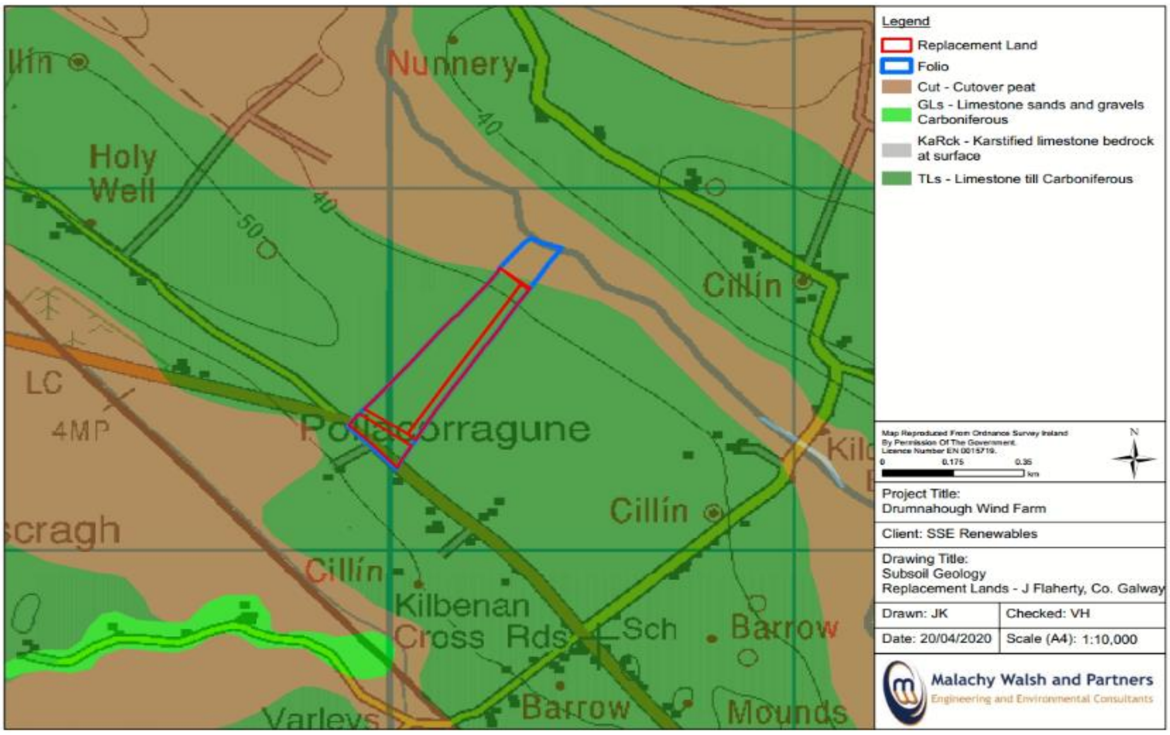

Figure 9-20: Subsoil Geology – Replacement Lands at Pollacurragune, Co. Galway

The soil for the County Galway site is "Grey Brown Podzolics/ Brown Earths Basic" as shown in **Figure 9-21**

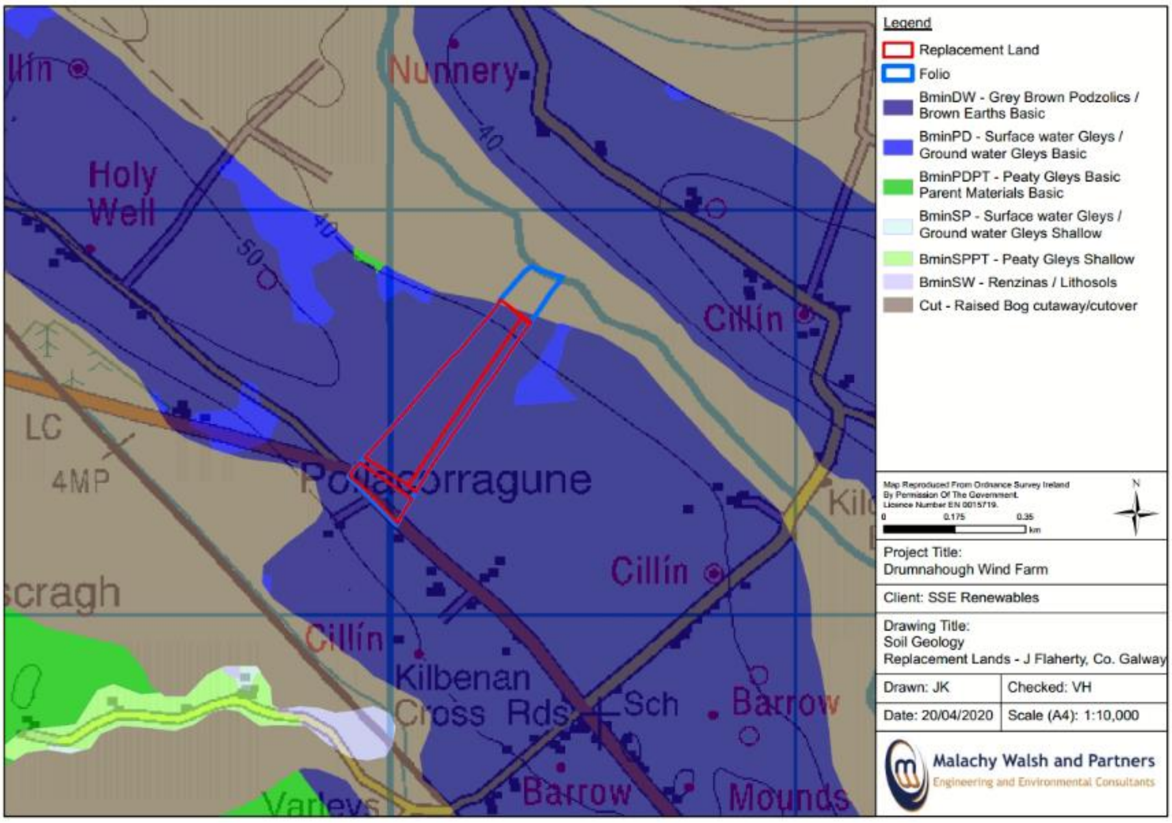

Figure 9-21: Soil Geology – Replacement Lands at Pollacurragune, Co. Galway

9.2.11Do Nothing Scenario

If no development associated with the proposed wind farm took place on this site, the land and soils environment would remain unchanged in the context of the development of the wind farm. It should be noted that forestry operations and agricultural activities will continue regardless of whether the wind farm development proceeds.

9.3 LIKELY SIGNIFICANT EFFECTS

The proposed works require the construction of turbine bases, hardstands, permanent met mast, borrow pits, material storage areas, peat deposition areas, internal roads, internal cable trenches, grid connection cable trenches and a proposed new substation and battery storage area. The removal of peat, subsoil and bedrock to form turbine bases, internal roads and cable trenches in addition to the interference with existing site drainage, is a direct permanent effect that, without mitigation, could alter the existing land and soils environment at the site. It could also impact on hydrological and hydrogeological balance of the site. This is addressed in more detail in Chapter 10, Water.

The natural land and soils environment at Drumnahough has been modified in large areas of the site as a result of agricultural practices and commercial forestry activity. These existing activities have disturbed the peat and subsoils in large portions of the site. Areas which have not been highly modified by agricultural and commercial forestry activities have been avoided or mitigated during the design process for Drumnahough Wind Farm. The potential impacts of the development on the soils, land and peat stability of the site are assessed below.

The potential impacts of the project on the land and soil environment discussed in the following sections are considered to be the worst case for all possible impacts if unmitigated.

9.3.1 Construction Phase

The predicted impacts on land and soils for the proposed development are discussed in the following sections. The activities that can cause damage to the existing geological environment, and may subsequently indirectly impact on the aquatic environment, include:

- Felling of Trees;
- Roads and drainage;
- Excavation Works;
- Rock blasting;
- Storage of Materials;
- Soil Erosion; and
- Waste Generation.

9.3.1.1 Land Use

The land area within the footprint of the proposed turbines, borrow pits, hardstandings, access roads, cable trenches, substation, batteries storage, permanent met mast and all other associated infrastructure will be sterilised from their existing land use for the duration of the wind farm's operational life.

The land within these areas can be reinstated at the end of operational life of the wind farm such that it can be used again for agricultural/ forestry purposes. The impact on land use is considered a slight negative direct long-term impact. Mitigation measures for land use are discussed in Section 9.4.1.2

9.3.1.2 Roads and Drainage

Approximately 12.1km of internal access roads with a typical running width of generally 5m are required within the site (8,900m of new access roads and 3,200m of upgrading the existing forestry access tracks on the site. Full details are provided in Chapter 2 of this EIAR.

A combination of new and upgraded drainage network will be installed within the site. The existing drainage network will be upgraded and settlement ponds and sediment traps installed at key locations. The drainage network has a twin system of water management separating out clean water from dirty water. The network and design approach are outlined in the Chapter 3 of this EIAR.

The construction of the roads and drainage network will involve both excavation and importation of soil/peat and crushed rock respectively. The impacts of the construction of roads and drainage are the same as for excavations discussed in 9.3.1.3. Given the modified nature of the land and soils environment at large parts of the site and the mitigation by avoidance approach adopted in the design, the construction of roads and drainage represent a moderate negative permanent impact.

Mitigation measures for roads and drainage construction are discussed in Sections 9.4.1.1 and 9.4.1.4.

9.3.1.3 Excavation Activities

The construction of the proposed development will result in the removal of soil, subsoil, peat and bedrock in parts of the site in order to facilitate the construction of the new access roads, turbine bases, crane hardstand areas, substation, cable trenches, permanent met mast and all other associated infrastructure. This removal of peat, soil and bedrock is a direct impact on the land and soil environment. However, it is not envisaged that the impact will have a significant effect. The volume of material to be excavated within the proposed wind farm will be managed, reused and stored locally on site. The material excavated from the proposed section of cable along the local public road associated with T1 and the grid connection to the permitted 110kv Lenalea substation will be removed to a suitably licensed/permitted facility. All other material will be reused or stored locally on site. Information on licensed/permitted facilities is given in the Project Description Chapter (Chapter 2).

The peat depths encountered at the site ranged from a minimum of 0.1m to a maximum of 4.5m. Mitigation by avoidance or mitigation through design was applied when choosing the proposed layout. This was done by selecting locations for development infrastructure with the shallowest peat in order to reduce earthworks volumes and to minimise impacts on the existing nature of the site. Existing forestry tracks are utilised as much as possible. The infrastructure proposed within blanket peat areas was also minimised in the design with preference given to placing infrastructure in areas already disturbed by conifer plantation or upland agricultural activities. The total volume of excavated material for the proposed development is approximately 368,400m3 of which peat accounts for approximately 255,300m^3.

The excavated materials, including peat and subsoil material, will be reused on site where feasible. Excavated peat will be reused in a number of ways onsite:

1. In the first instance, excavated peat will be used for the construction of roadside berms which isolate clean water and divert dirty water to appropriate treatment systems (silt trap, settlement ponds etc).

2. When rock has been extracted from the proposed borrow pits, the pits will be reinstated with peat and subsoil and become a permanent material storage area. These areas are referred to as BP/MSA on the planning drawings.
3. Following completion of the reinstatement of the borrow pits, any remaining excess peat will then be placed in the clear-felled conifer areas around Turbines T2, T3, T4, T5, T6, T7, T8, T11 and T12. These areas are referred to as Peat Deposition Areas on the planning drawings (see **Figure 9-22**). Areas around the turbines that do not currently contain conifer forestry will not be used for peat deposition.

Figure 9-22: Example of Peat Deposition and Borrow Pit / Material Storage Areas (BP/ MSA) near T5

The management of peat during construction is described in the EIAR Chapter 3 which includes a Peat Management Plan.

Excavated materials, other than peat, will be re-used on the site for landscaping, drainage berms and can be used to backfill turbine foundations as appropriate. The locations of the proposed borrow pits, material storage areas and peat deposition areas are shown on **Figure 9-1**.

In order to minimise the movement of excavated material within a site, a balance must be achieved in terms of how excavated material is managed and deposited on site. Four borrow pits and nine proposed felled conifer forestry areas have been identified. These locations are spread across the site to minimise the transport and handling requirements associated with peat and spoil. The phasing of the civil works and the schedule of handling peat only once is described in the EIAR Chapter 3.

Stone required for the construction of new roads, crane hardstandings, drainage, met mast foundation and turbine foundations will be largely won on site with some importation of higher quality material for fill under structures and finishing layers for roads and hardstands.

The volumes involved are typical of a construction project of this nature and size and do not represent a significant impact on the land and soils environment. A breakdown of the material volumes is given in EIAR Chapter 2 **Table 2-7**.

Vibrations caused by construction traffic, blasting or excavation activities near deep peat deposits, or the unsupported excavation of roads through areas of saturated and weak peat can trigger peat slides. The wind farm has been designed to avoid deep peat deposits and areas of higher risk of peat slides. A detailed peat stability assessment has been undertaken and is included in the Peat Stability Risk Assessment Report in EIAR Volume 3 Appendix E-1. Best practice construction stage mitigations have also been described in the Peat Stability Risk Assessment (PSRA)Report. Further information on peat at the site is given in Sections 9.2.9, 9.3.1.6 and 9.4.1.3 of this report as well as in the PSRA in Appendix E-1 of Volume 3 of the EIAR. This includes information on proposed responses to peat slide events in the unlikely event of one occurring.

Excavations associated with the development, if left unmitigated, represent a moderate long-term negative impact on the Land and Soils Environment. Mitigation measures for excavations and peat stability for this scheme are discussed in Section 9.4.1.4 and 9.4.1.3.

9.3.1.4 Rock Blasting

Blasting may be required at the borrow pits, turbine foundations and road cuttings. If blasting at these locations is required, it will result in some level of ground vibration and air overpressure. If uncontrolled and not properly mitigated, this could result in liquefaction of peat in the vicinity of the blast hole and could contribute to slope instability.

The intensity of vibration will depend on a number of factors including rock type and structure, weight/timing of explosive and distance from blast site. The seismic wave parameters used for correlation with structural damage is the peak particle velocity (PPV). It has been found that the safe limit for ppv below which structural damage is unlikely to occur is 50mm/s. British Standard BS 7385 Part 2: 1993, which provides guidance on vibration measurement, states that loose/waterlogged/cohesionless soils start to become vulnerable to liquefaction at ppv values of about 10 mm/s. The publication “Rock Engineering Guides to Good Practice Road Rock Slope Engineering” (Transport Research Laboratory 2000) refers to the range of ppv experienced for a wide variety of civil engineering projects, and shows that a ppv of > 10 mm/s is generally only experienced within 20 m of the blast holes if not properly mitigated.

Rock blasting also has the potential to result in excessive dust within the vicinity of the borrow pit which may affect the peat, soil or nearby aquatic environment.

The potential human and structural impacts associated with noise and vibration is dealt with in Chapter 5 (Population and Human Health), Chapter 8 (Air and Climate) and Chapter 11 (Noise) of this EIAR.

The impact of blasting represents a moderate temporary negative impact on the land and soil environment.

The mitigation measures for rock blasting are presented in Section 9.4.1.6.

9.3.1.5 Storage and Stockpiles of Excavated Materials

The handling, storage and re-use of excavated materials are of importance during the construction phase of the project. The Peat Stability Risk Assessment Report, available in Appendix E-1 Volume 3 of the EIAR, addresses the risk of peat slippage and how excavated peat should be managed on site, stored temporarily and re-used in landscaping.

Excavated peat will not be stored in excessive mounds on the site and will be managed in a manner that will not cause a risk of peat movement or sedimentation from runoff. The surplus peat will be deposited in a number of dedicated material storage areas and peat deposition areas.

The top layer of peat (acrotelm) can be set aside and re-used for natural re-vegetation onsite. Seeding of the work affected areas with indigenous species should proceed, only where natural re-vegetation is unsuccessful. The re-vegetation of these areas promotes stability, reduces desiccation, run-off erosion and susceptibility to freeze/thaw action.

There is potential for a slight negative medium-term impact on watercourses or water bodies as a result of the erosion of soil and the inappropriate temporary and permanent storage of excavated materials. However, any risk from the erosion of soil or stockpiling of excavated materials can be managed through good site practice. Furthermore, a robust Sediment and Erosion Plan has been included in the Civil Engineering Chapter which reduces any risk of sediment release to surface waters. The Water chapter of this EIAR outlines the impacts and mitigation measures relevant to Hydrology.

Mitigation measures for storage and stockpiling of material for this scheme are discussed in 9.4.1.7.

9.3.1.6 Impacts to Ground/Peat stability

The approach to, and method of, excavation of in-situ peat, rock and earth materials is very important for ground stability. Interference with the existing ground stability conditions, by inappropriate excavation methods, such as continuous vehicular movement over excavated peat, must be mitigated by appropriate construction methods, suitable for peat environments.

In order to address any potential concerns with peat stability, a detailed assessment of peat stability has been undertaken on this site (refer to Appendix E-1 Volume 3 of the EIAR). The peat stability assessment including desk study and fieldwork was completed over a number of weeks in 2019 and 2020. Extensive fieldwork was undertaken including peat probing, gouge coring, topographical survey, LiDAR and identification of water features on the site, all of which can have an impact on stability of peat. Higher risk peat stability areas identified in the Peat Stability Risk Assessment Report were avoided when designing the site layout and as such, it can be concluded that the risk of instability is low for the layout shown on the planning drawings.

Overall, it can be concluded the impact to ground stability is a slight negative short-term impact as a result of the proposed development.

Mitigation measures for ground stability are detailed in Section 9.4.1.3 and the Peat Stability Risk Assessment Report.

9.3.1.7 Vehicular Movement

The main vehicular movements relate to the following phases of development;

- Site mobilisation and temporary compound set up;
- Installation of the drainage network on new internal site service road and integration with the existing network;
- Delivery of construction materials;
- Vehicular traffic for employees;
- Excavation and formation of the roads network;
- Construction of the substation
- Excavation and construction of turbine bases and hardstands; and
- Delivery of turbines and commissioning.

Approximately 12,100m of internal access roads with a typical running width of 5m on straight sections of road are required within the site (7,100m of new access roads and 3,200m of upgrading the existing forestry tracks). Roads will be locally wider at bends and turning areas as shown on drawings 19715-MWP-00-00-DR-C-5005 to 5015. It is not envisaged that vehicular activity will have a negative effect on the existing peat and soil regime on site.

Vehicular movement will be contained on constructed tracks and roads and therefore will not impose a risk on peat areas on site in terms of stability risk. Roads will be constructed by advancing them from the existing or newly constructed sections of road to avoid tracking over peat. Specialised wide tracked machinery and excavators will be used in the limited circumstances where access over peat is necessary prior to road construction.

9.3.1.8 Hydrocarbon Release

Wherever there are vehicles and plant in use, there is the potential for hydrocarbon release which may contaminate the soil and subsoil. A spill has the potential to indirectly pollute water, if the soil and subsoil act as a pathway from any source of pollution. Any spill of fuel or oil would potentially present a slight long-term negative impact on the land and soils environment.
Good site practice and mitigation measures for hydrocarbon release are discussed in Section 99.4.1.9

9.3.1.9 Materials and Waste

Construction Materials

There will be four onsite borrow pit associated with the civil works at Drumnahough. Excavated materials will be re-used on the site and can be used to backfill turbine foundations as appropriate. Dedicated material storage areas and peat deposition areas will be used for excess peat. Additional materials will be imported, as required, and this includes crushed stone and hardcore, quarry run, ready-mix concrete, capping material for the roads, services ducts, pipe work and steel. A list of local quarries is given in EIAR Volume 2 Chapter 2. The handling, storage and management of excavated spoil will be carried out in line with the Construction Environmental Management Plan (CEMP) (See EIAR Volume 3 Appendix B-2).

Waste Generation and Management

During the construction phase, waste will be generated from the following activities:

- Construction waste from building materials such as cabling, ducts, concrete and any materials from the construction of the substation;
- Mixed organic waste from the temporary canteen and staff facilities;
- Mixed dry recyclables from the staff facilities;
- Toilet waste from the temporary welfare facilities; and
- Unused oil, diesel and building materials.

All waste will be managed, collected, stored and segregated in separate areas and removed off site by a licensed/permitted waste management contractor at regular intervals during the works.

During the course of the project, a certain amount of waste will be produced. **Table 9-3** below outlines the anticipated types of major waste streams that will be generated by the project

Table 9-3: Anticipated waste arisings on site

Waste item
Waste from Welfare Facilities
Waste Chemicals, Fuel and Oils
Packaging
Concrete
Waste Metals
Excavated Materials

In accordance with the waste hierarchy in Council Directive 98/2008/EC on waste and section 21A of the Waste Management Act 1996, as amended, waste management will be undertaken in order of priority, as follows:

(a)Prevention; (b)re-use; (c)Recycling; (d)Other recovery (including energy recovery); and (e) Disposal;

Waste generation is principally avoided through planning and management of activities and good housekeeping.

The procurement of material inputs are generally in bulk. By bulk procurement, the generation of small-sized containers and packaging is largely avoided and thus minimises the generation of unnecessary waste requiring recycling or disposal.

In line with the Waste Hierarchy, wherever possible, packaging will be returned to originator for reuse ahead of recycling or disposal.

Otherwise waste packaging will be segregated and stored on site in appropriate skips within the construction compound and disposed of in accordance with waste management regulations.

Skips will be clearly labelled for plastics, timber, steel and other waste materials to ensure segregation. Materials will be placed in these and can be reused as required during construction.

Mitigation measures for materials and waste are discussed in Section 9.4.1.8 and 9.4.1.9.

9.3.1.10 Replacement Forestry Lands

The impacts envisaged during the construction phase for the replacement lands will be similar to the wind farm site. The planting of the replacement lands will involve construction of access tracks and installation of a drainage network. These elements of the works will involve the same construction processes as the construction works at the wind farm site as described in the Civil Engineering Chapter. The impact to the soils environment from planting forestry on replacement lands is considered a slight negative long-term reversible impact.

Land use at these sites will be altered from agricultural land to forestry land. The impact to the land environment from planting forestry on replacement lands is considered a neutral long-term reversible impact.

Mitigation measures relevant to the construction of access tracks and installation of drainage networks associated with the plantation of replacement lands are discussed in Sections 9.4.1.4, 9.4.1.7, 9.4.1.8, 9.4.1.9, 9.4.1.10, and 9.4.1.11.

9.3.2 Operational Phase

The potential impact on the land and soils of the site due to excavations will be much lower during operation and maintenance, as the majority of excavations will have been reinstated. There is some potential for excavations associated with drainage, road and cable maintenance however these will be small in scale and infrequent in comparison to the construction phase. Maintenance works on turbines will be carried out from the existing roads and hardstands. Some erosion of soil will continue into the operation phase, however as vegetation becomes established and equilibrium is achieved, erosion rates will reduce to pre-construction levels.

All vehicular movement during operation and maintenance will be restricted to the areas of hardstanding and existing/newly constructed access roads. Traffic levels will be very low during the operational phase in comparison to the construction phase.

The impact due to operation and maintenance of the wind farm, grid connection, substation and all other infrastructure associated with the development represent slight medium-term negative impacts on the land and soil environment.

The mitigation measures appropriate to the operation and maintenance of the wind farm are presented in Section 9.4.2.

9.3.3 Decommissioning Phase

Turbine components will be removed at decommissioning stage however it is envisaged that access roads will remain in place. Hardstand and turbine foundation areas will be left in situ and covered with soil to match the existing landscape. As such, the decommissioning phase of the project will require minimal earthworks. The potential impacts associated with decommissioning will be similar to those associated with construction but of a reduced magnitude because extensive excavation and wet concrete handling will not be required. The impact of the development on land and soils at decommissioning phase is considered a slight negative long term impact.

Mitigation measures for the decommissioning phase are discussed in Section 9.4.3.

9.3.4 Cumulative effects

The cumulative impacts due to the interaction with other nearby developments and activities have been considered. Projects identified and considered to potentially result in cumulative impacts would include: land-use change, continued growth in wind energy development, afforestation, and agricultural intensification. These developments and activities include ongoing forestry activity, the potential decommissioning and repowering of Cark Wind Farm, the ongoing operation of Meentycat Wind Farm, the potential construction of Lenalea Wind Farm and maintenance/upgrades existing public roads in the area.

Due to the localised nature of the proposed construction works which will be kept within the proposed development site boundary, there is no potential for significant cumulative effects in-combination with any other local developments (refer to Chapter 2) on the land, soils and geology environment. The only way the proposed development can have in combination effects with other off site projects and plans is via the drainage and off site surface water network and slope movement in the form of peat slides. The hydrological pathway is assessed in Chapter 8. The risk posed by peat slides at the site is considered negligible as higher risk areas of the site have been identified and avoided as part of the layout design (See Peat Stability Risk Assessment in Volume 3 Appendix E-1).

9.4 MITIGATION MEASURES

Appropriate mitigation measures to avoid or reduce the potential impacts of the proposed development at Drumnahough are outlined in this section. The design of the layout has incorporated consideration of the existing land and soils environment at the site.

Specific mitigation measures in respect of peat, subsoil and bedrock excavation and removal are addressed below in terms of:

- Design
- Land Use
- Slope Failure
- Excavations
- Rock Blasting
- Storage and Disposal of Excavated Materials
- Waste Generation
- General Site Management
- Drainage
- Surface Water
- Replacement Forestry Lands

9.4.1 Construction Phase

9.4.1.1 Mitigation by Design

The design of the layout has incorporated consideration of the existing land and soils environment at the site. A mitigation by avoidance of potential impacts approach has been applied to the layout shown in the planning drawings. This has been discussed in the impacts section of this chapter.

Turbine locations, the alignment and rotation of the hardstands, and the routes of proposed new access roads were designed to optimise the balance between access criteria and the required volumes of excavated and imported materials. The use of existing wind farm roads was maximised.
The risk of peat instability within the site has been assessed and used in the design of the layout of the wind farm. Higher risk areas have been avoided throughout the site. This can be seen on the peat stability risk maps in the Peat Stability Risk Assessment Report. Full details of the peat stability assessment process, investigations, analysis and results are presented in the Peat Stability Report included in Appendix E-1 Volume 3 of the EIAR.

9.4.1.2 Mitigation Measures for Land Use

The lands across the Drumnahough site can be reinstated at the end of operational life of the wind farm such that it can be used again for agricultural or commercial forestry purposes. The area of land required to construct, operate, maintain and ultimately decommission the wind farm has been kept to the minimum reasonably practicable area as part of the design process. Existing access roads have been utilised in the design as much as possible such that the existing land use does not change in these areas of the site during the operational life of the wind farm. This approach minimises the area temporarily sterilised from its current land use.

9.4.1.3 Mitigation Measures for Slope Failure/Ground Instability

In order to address any potential concerns with peat stability, a detailed assessment of peat stability has been undertaken on this site. The Peat Stability Risk Assessment Report is included in Appendix E-1 Volume 3 of the EIAR. The peat stability assessment, presented in the Peat Stability Risk Assessment Report, identified areas of higher risk of instability within the site. These higher risk areas were used as a constraint when designing the layout of the wind farm and were actively avoided when designing the wind farm layout. This process has ensured that infrastructure was only placed in lower risk areas and hence it can be concluded that the risk of instability is low for the proposed infrastructure.

Any construction within the peat depths and topography encountered at the proposed infrastructure locations within this site does not present a significant level of risk for a peat environment. The output of the analysis presented in the Peat Stability Risk Assessment Report (See Volume 3 Appendix E-1) was that the area represented a **Low to Low-Moderate Hazard Rating** for peat slide. The output of the Peat Landslide Hazard Risk Assessment in the same report was that peat landslide presented a **Negligible Risk** to the infrastructure of the Wind Farm and surrounding area.

Designing the wind farm to avoid higher risk areas was the main mitigation measure applied to the proposed wind farm.
The findings of the Peat Stability Risk Assessment is that there is a **Negligible Risk** to the project therefore no further planning stage design measures are considered necessary.

Peat monitoring by sightline monitoring method shall be carried out by the appointed contractor for this development. Monitoring will be carried out at areas of deep excavations (eg turbine bases), material deposition areas and any area of works with a risk rating higher than "low"

Monitoring by sightlines entails driving a series of posts at approximately 5m centres, exactly aligned, across the section of bog being monitored. Any signs of distress or deformation in the bog will quickly manifest itself by some of the posts moving out of alignment. Early discovery of stress in the peat will give the developer a opportunity to implement emergency procedures to prevent the onset of a bog burst or localised peat slide. While the risk of such occurrence is low in this instance, the precautionary principle dictates that monitoring posts should be installed in work areas where there are areas with a risk rating higher than “low” adjacent to the works area. Emergency procedures are the responsibility of the appointed contractor and are to be included in the appointed contractors method statements. As a minimum, the following shall be included in the contractor’s methodologies:

- Emergency response procedures to protect the health and safety of workers and to implement containment procedures for remoulded peat slurry on or off site.
- Identification of potential flow paths of peat slides to determine accessible intervention points on or off site to construct barrages, settlement ponds and silt traps to contain the peat slurry and to prevent downstream contamination of watercourses.
- Stockpiling of rockfill on or off site to use in the construction of emergency containment barrages in the event of a slide.

The Construction Manager for the project should impart the philosophy that everyone on the site is aware of peat stability and report any sign of misalignment in monitoring posts. Vigilance is a fundamental requirement when working on peat where inappropriate construction methodology can cause instability in otherwise benign conditions.

A Geotechnical Engineer experienced in working in the upland peat environment should be employed full-time to ensure the implementation of best practice in this environment. The methodology of all civil works should be reviewed by the Geotechnical Engineer and the monitoring posts should be the subject of a dedicated inspection on a weekly basis by the Geotechnical Engineer.

In order to manage construction risk within this site, the following shall be implemented;

1. All site excavations and construction will be supervised by a suitably experienced engineer. The Contractor’s method statements for each element of work will be reviewed and approved by the engineer prior to site operations. Specific method statements will be developed for each turbine and hardstanding location within the site.

2. Particular emphasis will be placed in the Contract that only operators of proven experience in working in peatlands are employed for any work element involving excavation, handling or placement of peat.

3. Prior to excavation, drains will be established to effectively intercept overland flow prior to earthworks.

4. The existing network of drainage within the site will be utilised whenever possible.

5. Due to peat’s fluid-like properties, all peat excavated will be immediately removed from work areas. If peat is required for reinstatement, then acrotelm peat (<0.5m shallow, living layer) will be stripped off the surface of the excavated area and placed carefully at the margins of the work area along the access road and hardstand margins that are characterised by near-horizontal slopes (<3^{o}).

6. From evidence of previous landslides (Derrybrien Landslide in Co. Galway (2003) and Pollatomish Landslide Co. Mayo (2003)) and historic occurrences, it is strongly recommended that construction activities will be assessed for impact after prolonged periods of heavy rainfall. Reference: Landslides in Ireland, GSI Landslide Working Group, 2006.

7. From examination of factual evidence to date, the majority of peat slides occur after an intense period of rainfall (Landslides in Ireland, GSI Landslide Working Group, 2006). An emergency response system will be developed for the construction phase of the project, particularly during the early excavation phase. This, as a minimum, will involve 24 hour advance meteorological forecasting (Met Eireann download) linked to a trigger-response system. When a pre-determined rainfall trigger level is exceeded (e.g. 1 in 100 year storm event or very heavy rainfall at >25mm/hr), planned responses are undertaken. These responses will include cessation of construction until the storm event, including storm runoff, has passed over. This requirement is also included in the CEMP.

9.4.1.4 Mitigation Measures for Excavation

One of the primary mitigation measures already employed at the design stage has been the minimisation of volumes of peat excavation and lengths of road construction by judicious design of access road and turbine locations which have been designed to avoid areas of deeper peat. Floated roads will be utilised in circumstances where peat depths are greater than 1m, with the exception of roads immediately adjacent to crane hardstands, which also aids the minimisation of volumes of peat excavation.

Whenever possible, existing forestry tracks have been utilised to access turbine locations. This reduces the volume of excavated material and imported crushed rock for road construction.

The peat excavated from turbine bases, hardstanding, roads, cable routes, grid connection, substation etc., during construction will be reused for localised landscaping and reprofiling with excess peat deposited in the material storage areas and peat deposition areas. Excavation will be carried out from access roads or hardstanding areas to reduce the compaction of peat.

Excavation of the peat and construction of the new access roads will be carried out by excavation of the peat followed by placement of a separation layer (e.g. terram), followed by replacement with compacted crushed rock. Machinery will not operate directly on excavated/stockpiled peat.

Drainage will be constructed in parallel with road construction and turbine excavation. Drainage (including drains, stilling ponds etc) will be constructed using bog mats or “bogmaster” excavators when working in deeper peat area. These are wide tracked excavators, specially designed for use in peat areas. The wide tracks reduces the pressure applied to the peat.

This approach will be used in combination with the installation of other drainage protection measures in advance of construction, such as the installation of silt fencing or other waterway protection measures. Further details are given in the Civil Engineering (Chapter 3) and Water chapter (Chapter 10).

Excavations for turbine foundations, hardstands and the roadway from T8 to T9 and the borrow pits will be the largest scale excavations at Drumnahough. This will involve creating safe side slope angles, installation of drainage around and within the excavation and installation of sediment control measures within the drainage system. Further detail is provided in the Civil Engineering Chapter (Chapter 3)

Within excavations and around excavations, pore water pressure will be kept low by avoiding loading the peat with spoil or machinery and giving careful attention to the existing drainage and how structures could affect it. Removal of peat to approved material storage areas and peat deposition areas will avoid the need for storage adjacent to excavations.

All temporary cuts/excavations will be carried out such that they are stable or adequately supported. Cuts and excavations will be protected against ingress of water or erosion by the use of cut off drains around the excavation works. Temporary works will be such that they do not adversely interfere with existing drainage channels/regimes.

Plant and materials will be stored in approved locations only (such as the proposed site compounds) and will not be positioned or trafficked in a manner that would surcharge existing or newly-formed slopes (Refer to CEMP in EIAR Volume 3 Appendix B-2 for further details).

Excavated peat from the cable route will be used to landscape and reinstate the area around the cable trench following backfilling of the trench with approved materials. The angle of the peat reinstated at the top of the infilled trenches will not exceed 5º.

Vehicular movements will be restricted to the footprint of the permitted development, particularly with respect to the newly constructed access roads. This means that machinery must be kept on roads and aside from advancing excavations.

9.4.1.5 Mitigation Measures for Excavation associated with Cable Trenching

The removal of soil, subsoil and bedrock is an unavoidable impact of the construction of the cable trenches but every effort will be made to ensure that the amount of earth materials excavated is kept to a minimum in order to limit the impact on the land and soils aspects of the site. Some of the overburden material will be used in the re-instatement of turbine excavations and cable trenches. All other material will be removed to designated storage areas with the exception of material from trenches constructed along the local road which will be removed to suitably licensed/permitted waste facilities.

Temporary storage of material beside the trenches will be done in line with the CEMP (See EIAR Volume 3 Appendix B-2). Site management will include the checking of equipment, materials storage and transfer areas, drainage structures and their attenuation ability on a regular basis during the construction phase of the project. The purpose of this management control is to ensure that the measures in place are operating effectively, prevent accidental leakages, and identify potential breaches in the protective retention and attenuation network during earthworks operations.

9.4.1.6 Mitigation Measures for Rock Blasting

Borrow pits have been located within areas of thin peat cover and low susceptibility to landslide.
In order to further mitigate against possible peat instability close to the borrow pits, blasting will not occur after periods of heavy rainfall. In particular, no blasting will take place for at least 24 hours following a period of rainfall which exceeds 25mm within the previous 24 hours.

Rock blasting will only take place within borrow pits if extraction using rippers or hydraulic breakers is deemed impractical. Circumstances include where the rock strength is such that other means of extraction are not possible and production rates need to be increased to keep up with the construction programme. If rock blasting proves to be necessary, a detailed blasting design will be undertaken by a suitably qualified and experience specialist for each borrow pit to ensure that a peak particle velocity (PPV) of 10 mm/s is not exceeded at a distance of greater than 20m from the blast holes as per BS 7385 Part 2: 1993. If this cannot be achieved, blasting will not be permitted at this location. To mitigate against the risk of slope failure occurring, blasting will not be permitted at turbine locations unless robust mitigation measures are put in place. Blasting for the road cuttings and hardstands will be subject to the same rigorous controls as that proposed at borrow pit and turbine foundation locations.

To mitigate against the risk of excessive dust within the vicinity of the borrow pits, the blast areas will be lightly sprayed with water prior to blasting.

A rock blasting plan will be prepared as part of the CEMP and will ensure compliance with Explosives Act 1875 and related Legislation and BS 7385 in relation to blasting. Donegal County Council and adjoining landowners will be notified in advance of any blasting activities on the site.

Additionally, the NPWS will be consulted as part of the general consultation and blasting permitting process in order to keep them informed of any blasting proposals for the site.

9.4.1.7 Mitigation Measures for the Storage and Management of Excavated Material

The risks associated with peat placement has and will be mitigated by the following measures:

- Reducing overall peat excavation by design of access road and turbine location;
- The planting and re-seeding of material storage areas and peat deposition areas will provide resistance against rainfall events, and will minimise sediment and nutrient release until natural re-vegetation is established as discussed above.

Drainage measures will be provided for the reinstated material storage areas and peat deposition areas as presented in the EIAR Vol 2 Chapter 3 Sections 3.14 to 3.17; this will include cut-off drains at the top of slopes, toe drains at the base of slopes, settlement ponds and silt fencing as required.

Any runoff from the peat deposition areas in the clear felled areas near turbines will be treated using the same design philosophy as that for the roads and hardstands. This includes the separation of clean and dirty water by the installation of berms, channelling dirty water to silt traps and settlement ponds and ensuring that the discharge rate of the drainage system is no higher than the existing condition by using engineered settlement ponds. The drainage system shall be installed prior to placement of peat. Refer to EIAR Vol 2 Chapter 3 for greater detail on the design philosophy behind each of the drainage measures.

The handling, storage and management of excavated spoil will be carried out in line with the Construction Environmental Management Plan (CEMP). Site management will include the checking of equipment, materials storage and transfer areas, drainage structures and their attenuation ability on a regular basis during the construction phase of the project. The purpose of this management control is to ensure that the measures in place are operating effectively, prevent accidental leakages, and identify potential breaches in the protective retention and attenuation network during earthworks operations.

9.4.1.8 Waste Management

A construction phase waste management plan has been developed to control all site generated construction waste and the storage and disposal of same (See Section 5 of the CEMP in Appendix B-2 EIAR Volume).

Any introduced semi-natural (road building materials) or artificial (PVC piping, cement materials, electrical wiring) materials must be taken off site at the end of the construction phase, except for material that forms part of the permanent works. Any accidental spillage of solid state introduced materials must be removed from the site by the appropriate means. This is detailed further in the Material Assets Chapter of the EIAR (Chapter 15) and Section 9.3.1.9 of this chapter.

9.4.1.9 General Site Management

The CEMP will include the checking of equipment, materials storage and transfer areas, drainage structures and their attenuation ability on a regular basis during the construction phase of the project. The purpose of this management control is to ensure that the measures in place are operating effectively, prevent accidental leakages, and identify potential breaches in the protective retention and attenuation network during earthworks operations.

Aa fuel management plan will be implemented and will incorporate the following elements:

- Mobile bowsers, tanks and drums will be stored in secure, impermeable storage area, 50m away from drains and open water;
- Fuel containers must be stored within a secondary containment system e.g. bund to 110% of volume for static tanks or a drip tray for mobile stores;
- Ancillary equipment such as hoses, pipes must be contained within the bund;
- Taps, nozzles or valves must be fitted with a lock system;
- Fuel and oil stores including tanks and drums will be regularly inspected for leaks and signs of damage;
- Only designated trained operators will be authorised to refuel plant on site;
- Procedures and contingency plans will be set up to deal with emergency accidents or spills;
- An emergency spill kit with oil boom and absorbers will be kept on site in the event of an accidental spill. All site operatives shall be trained in its use.

9.4.1.10 Drainage

The permanent road works will require a drainage network to be in place for the construction and operation phases of the wind farm. Fundamental to any construction phase is the need to keep clean water (i.e. runoff from adjacent ground upslope of the permitted development footprint) clean and manage all other run off and water from construction in an appropriate manner. This will necessitate the implementation of the Sediment and Erosion Plan, with associated settlement ponds and silt traps. The Sediment and Erosion Plan forms part of the CEMP for the site,. The Sediment and Erosion Plan, included in the Civil Engineering chapter, is included as a design feature thereby applying mitigation by Design.

9.4.1.11 Surface Water

To ensure that there is no adverse impact on surface water flow or quality, a regular programme of environmental audit and site maintenance of the constructed drainage and attenuation structures (e.g. settlement ponds, buffered outfall) and drainage crossings is required to ensure attenuation performance to regulatory standards at the site. Mitigation measures for hydrology are fully described in Chapter 3 and Chapter 10 of this EIAR.

9.4.1.12 Replacement Forestry Lands Mitigation Measures

The mitigation measures for the replacement lands will be the same as those at the wind farm site as discussed in previous sections. These include mitigation measures for excavation, drainage, siltation control, hydrocarbon release and general site management and will be fully in line with any requirements identified in the Technical Approvals that have been provided for each site. The land use at these locations will be changed to forestry. At the end of the forestry lifetime, the land can be converted back to its current agricultural use.

9.4.2 Operational Phase

The potential impact on the land and soils environment of the site due to excavations will be lower during operation and maintenance, as the majority of excavations will have been reinstated. Some erosion of soil may continue into the early stages of the operational phase as reinstated areas will initially have bare soil. However as vegetation becomes established and equilibrium is achieved, erosion rates will reduce to normal levels. Sediment control measures will remain in place onsite during the above period.

All vehicular movement during operation and maintenance will be restricted to the areas of hardstanding and existing/newly constructed access roads. The volume of traffic during the operational phase will be greatly reduced in comparison with the construction phase. The potential impact on slope stability will therefore be small.

At the replacement lands, the potential impact on the land and soils environment of the site due to excavations will be lower during operation and maintenance, as the excavation work will have been completed during preparation of the site prior to planting trees. Some attendance at the replanted lands will be required during the operational phase. In these circumstances, all vehicular movement during operation and maintenance will be restricted to the areas of forestry tracks to avoid tracking over land and soils within the area.

At both the wind farm development and the replacement lands, the risks associated with sedimentation and contamination of the watercourses and aquifers due to erosion and runoff will be reduced to minimal levels as areas are revegetated and construction/forestry traffic ceases. Refer to EIAR Chapter 10 for further details in relation to hydrology and hydrogeology.

9.4.3 Decommissioning Phase

Decommissioning will comprise the removal of the turbines at the end of the operating lifetime of the wind farm. Access roads are likely to be left in place and hardstanding areas will be reinstated. Concrete bases will be left in the ground, covered with topsoil and allowed to naturally re-seed in line with IWEA best practises (IWEA, 2017). The area around the bases will be rehabilitated by covering it with locally sourced soil in order to regenerate the vegetation. This will also reduce run-off and sedimentation effects. The mitigation measures for decommissioning form part of the environmental assessment required at the end of the design life of the wind farm.

At the end of the forestry lifetime in the replacement lands, the felling will be subject to the requirements of a felling licence and adherence to the environmental mitigation measures associated with the licence.

9.4.4 Cumulative Impacts

Based on the finding that the cumulative impact on land and soils arising from the proposed development and replacement lands is considered to be slight negative, and considering the static nature of the land and soils environment, no specific measures to mitigate against cumulative impacts are considered necessary. Implementation of the mitigation measures proposed for the construction, operational and decommissioning stages of the proposed development will mitigate against cumulative impacts associated with the land and soils environment

9.5 RESIDUAL IMPACTS

Given the main risks to the land and soils environment have been identified and avoided as part of the design process and the modified nature of large parts of the site, and in light of the proposed works and the mitigation measures outlined above, it is considered that there will be no significant residual impact to land and soils environment due to the development and operation of this project.

9.6 CONCLUSION

The proposed development does not constitute a significant effect on the land and soils environment, either alone or in cumulation with other existing and/or approved projects.

REFERENCES

County Geology of Ireland: Donegal, Geoschol, Patrick Wyse Jackson & Mike Simms, 2009. Accessed via Geological Survey of Ireland on 07th May 2020, https://www.gsi.ie/en-ie/publications/Pages/Geoschol-Donegal-Geology.aspx

Environmental Protection Agency, Corine Land Cover Data for Ireland, 2012, accessed on 07th May 2020, https://www.epa.ie/pubs/data/corinedata/#d.en.51993.

Geohive 2020, Online Map Viewer, viewed on 7th May 2020, https://geohive.ie/

Geological Survey of Ireland 2020, Online Geological Map Viewer, viewed on 7th May 2020, https://www.gsi.ie/en-ie/data-and-maps/Pages/default.aspx

Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements, Institute of Geologists of Ireland, 2013, viewed on 07 May 2020, http://igi.ie/assets/files/Codes%20and%20Guidelines/IGI%20Enviro%20Impact%202013.pdf

Landslides in Ireland, GSI Landslide Working Group, 2006.

Nichol, D., 2006. Peatslide hazard rating system for wind farm development purposes. Proceedings of the 28th Annual Conference of the British Wind Energy Association (BWEA28), 10-12 October 2006, Glasgow, B2.

Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments, Energy Consents Unit Scottish Government, Second Edition, April 2017