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13 GEOLOGY, SOILS AND PEAT

13.1 Introduction

- 13.1.1 This Chapter of the Environmental Impact Assessment Report (EIA Report) provides an appraisal on the effect of Torrance Wind Farm Extension II (the Proposed Development) on the geology, soils, and peat within the Study Area as defined in Section 13.3.3 of this EIA Report. This assessment was undertaken by Arcus Consultancy Services Limited (Arcus), an ERM Group company, with mining risk assessment undertaken by Wardell Armstrong.
- 13.1.2 This Chapter is supported by the following Technical Appendix (TA) documents provided in Volume 4 Technical Appendices:
- Technical Appendix 13.1: Coal Mining Risk Assessment (CMRA).
- 13.1.3 This Chapter is also supported by the following figures provided in Volume 2 EIA Report Figures:
- Figure 13.1: Site Layout
 - Figure 13.2: Superficial Soils;
 - Figure 13.3: Bedrock Geology;
 - Figure 13.4: National Soils of Scotland;
 - Figure 13.5: Extract from Carbon and Peatland 2016; and
 - Figure 13.6: Interpolated Peat Depths.
- 13.1.4 This Chapter is structured as follows:
- Legislation, Policy and Guidance;
 - Assessment Methodology and Significance Criteria;
 - Scoping Responses and Consultation;
 - Baseline Conditions;
 - Assessment of Potential Effects;
 - Assessment of Cumulative Effects;
 - Mitigation Measures;
 - Residual Effects; and
 - Summary.

13.2 Legislation, Policy and Guidance

- 13.2.1 National Planning Framework 4 (NPF4)¹ was adopted in February 2023 and sets out the Scottish Government's policy on how nationally important land use planning matters should be addressed.
- 13.2.2 In relation to peat and organic soils, policy 5a of NPF4 states that developments will only be supported if they are designed and constructed if they are designed and constructed as per the mitigation hierarchy by firstly avoiding and then minimising the amount of disturbance to soils on undeveloped land.

¹ The Scottish Government (2023) National Planning Framework 4 [Online] Available at: <https://www.gov.scot/publications/national-planning-framework-4/pages/1/> (Accessed 23/02/2023)

13.2.3 Policy 5c², ii of NPF4 details that:

"Development proposals on peatland, carbon-rich soils and priority peatland habitat will only be supported for:

ii. The generation of energy from renewable sources that optimises the contribution of the area to greenhouse gas emissions reductions targets."

13.2.4 where peat and other carbon rich soils are present, applicants should assess the likely effects of development on carbon dioxide (CO₂) emissions. Where peatland is drained or otherwise disturbed, there is likely to be a release of CO₂ to the atmosphere. Developments should aim to minimise this release.

13.2.5 This Chapter is guided by The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations (2017)³ (the EIA Regulations) which establishes, in broad terms, what is to be considered when determining the effects of development proposals on Geology, Soils and Peat.

13.2.6 Additional guidance includes:

- Nature Scot (NS), formerly Scottish Natural Heritage (SNH), (2019), Good Practice During Wind Farm Construction⁴;
- The Scottish Government (2017), Peat Landslide Hazard and Risk Assessments – Best Practice Guide for Proposed Electricity Generation Developments⁵;
- Scottish Government, Scottish Natural Heritage, SEPA (2017) Peatland. Guidance on Development on Peatland, online version only⁶;
- The Scottish Government (2009), The Scottish Soil Framework⁷;
- The Construction Industry Research and Information Association (CIRIA) (2015), Environmental Good Practice on Site (C741)⁸;
- Planning Advice Note PAN 50 Controlling the Environmental Effects of Surface Mineral Workings⁹; and
- Environmental Protection Act 1990, Part IIA¹⁰.

² The Scottish Government (2023) National Planning Framework 4 [Online] Available at: <https://www.gov.scot/publications/national-planning-framework-4/pages/3/> (Accessed 23/02/2023)

³ The Scottish Government (2017) The Electricity Works (Environmental Impact Assessment) (Scotland). Available at: <https://www.legislation.gov.uk/ssi/2017/101/contents/made> (Accessed 12/05/2022)

⁴ SNH (2015b) Good practice during windfarm construction, 3rd Edition [Online] Available at: <http://www.snh.gov.uk/docs/A1168678.pdf> (Accessed 12/05/22)

⁵ The Scottish Government (2017) Peat Landslide Hazard and Risk Assessments – Best Practice Guide for Proposed Electricity Generation Developments Guidance [Online] Available at: <http://www.gov.scot/Resource/0051/00517176.pdf> (Accessed 12/05/22)

⁶ Scottish Government, Scottish Natural Heritage, SEPA (2017) Peatland Survey. Guidance on Developments on Peatland, on-line version only Available at: <https://www.gov.scot/Resource/0051/00517174.pdf> ([webarchive.org.uk](https://www.webarchive.org.uk)) (Accessed 12/05/22)

⁷ The Scottish Government (2009) The Scottish Soil Framework [Online] Available at: <http://www.gov.scot/Publications/2009/05/20145602/0> (Accessed 12/05/22)

⁸ The Construction Industry Research and Information Association (CIRIA) (2015) Environmental Good Practice on Site Guide (C741), CIRIA: London. (Accessed 12/05/22)

⁹ Scottish Government (1996) Planning Advice Note 50: Controlling the Environmental Effects of Surface Mineral Workings. Available at: [https://www.gov.scot/publications/planning-advice-note-pan-50-controlling-environmental-effects-surface-mineral/ PlanningAdviceNote50:controllingtheenvironmentaleffectsofsurfacemineralworkings-gov.scot\(www.gov.scot\)](https://www.gov.scot/publications/planning-advice-note-pan-50-controlling-environmental-effects-surface-mineral/PlanningAdviceNote50:controllingtheenvironmentaleffectsofsurfacemineralworkings-gov.scot(www.gov.scot)) (Accessed 12/05/22)

¹⁰ UK Government (1990) Environmental Protection Act, Part IIA. Available at: <https://www.legislation.gov.uk/ukpga/1990/43/part/IIA> (Accessed 12/05/2022)

13.3 Assessment Methodology and Significance Criteria

Scope of Assessment

- 13.3.1 The key issues for the assessment of potential Geology, Soils and Peat effects relating to the Proposed Development.
- Temporary effects arising from the construction phase such as ground instability and exposure to contaminated soils;
 - Permanent effects; and
 - Indirect effects, including creation of pollutant linkages as a result of construction works.
- 13.3.2 Following completion of Phase 1 peat probing it was concluded that no significant peat deposits are present on the Site. Therefore, the requirement for the completion of an Outline Peat Management Plan (OPMP) and Peat Slide Risk Assessment (PSRA) as part of this EIA Report has been scoped out of this assessment.

Study Area

- 13.3.3 For the purposes of this Chapter, the study area is defined as the area within the planning redline boundary as displayed in Figure 13.1, herein referred to as the 'Site'. This is considered to be the area in which activities at the Site could have a potential influence, while the Proposed Development considers the footprint of proposed infrastructure.
- 13.3.4 The Site is entirely within the North Lanarkshire Council (the Council) administrative area; however, the administrative boundary with West Lothian Council (WLC) is immediately adjacent to the northern boundary of the Site.

Survey Methodology

- 13.3.5 A desk study and site reconnaissance were undertaken for the Proposed Development which included an overall appraisal of geology and ground conditions, contaminated land assessment and mining assessment, informing the overall assessment and conclusions for this Chapter. The desk study identified constraints and sensitive receptors requiring further consideration and informed site surveys and contributed to the overall site layout evolution.
- 13.3.6 Initial Phase 1 peat probing was carried out in May 2020, covering the Site area. This phase of probing comprised probes being sunk in a 100 m grid across the entire Site area, where possible. The data gathered during this survey helped to inform the initial Site layout design. The information gathered was analysed and it was determined that Phase 2 probing and a PSRA would not be required due to the absence of peat on the Site.

Assessment Methodology

- 13.3.7 The assessment of geology and peat has included the review of publicly available information in relation to the current condition of the soils at the Site, the information is detailed in Section 13.5 of this Chapter. This was supported by detailed site walkover surveys. The information has been reviewed in the context of the Proposed Development to evaluate both short- and long-term impacts. The assessment has involved a review of the following data sources:
- National Soils Map of Scotland¹¹;
 - Carbon and Peatland 2016 Map¹²;
 - British Geological Survey (BGS) Geoindex – Superficial Soils¹³; and
 - BGS Geoindex – Solid Geology¹⁴.
- 13.3.8 Soil types are considered to be of high sensitivity where they are categorised as peat soils of high moisture content, such as those found in blanket bog.
- 13.3.9 Given the recorded deep and shallow historical mining activities recorded on the Site, as detailed in Technical Assessment A13.1: CMRA, and the potential for waste arisings, the presence of made ground and other contamination sources are considered in this assessment.
- 13.3.10 In relation to mining and the associated risk, the assessment considers the risk to the Proposed Development from historical shallow mine workings, mine entries and areas of previous underground mining. A Coal Mining Risk Assessment was undertaken by Wardell Armstrong included in Technical Appendix A13.1, and the findings of this assessment are considered in terms of EIA and the significance of effects on the Proposed Development as a receptor.
- 13.3.11 Using experience from other wind farm projects, the assessment endeavours to assess the magnitude of change on geology and soils either affected directly or indirectly by construction or operation of the Proposed Development.

Sensitivity of Receptors

- 13.3.12 The sensitivity of the baseline conditions, including the importance of environmental features on or near to the Site, or the sensitivity of potentially affected receptors, will be assessed in line with good practice guidance, legislation, statutory designations and / or professional judgement.
- 13.3.13 The sensitivity of the receiving environment is defined as its ability to absorb an effect without perceptible change and can be classified as very high, high, medium, low or negligible. These classifications are dependent on factors such as the nature and extent of peat, associated habitats, and soil characteristics as well as the Site geology, purpose and existing influences, such as land-use.
- 13.3.14 Table 13.1 provides an overview of the different categories of sensitivity that are used within this Chapter to inform the assessment of effects on existing geology and peat and to identify whether the effects would be significant under EIA Regulations.

¹¹ Scottish Government (2021) Scotland's Soils - National soil map of Scotland [Online] Available at: https://map.environment.gov.scot/Soil_maps/?layer=1 (Accessed 17/12/2021)

¹² Scottish Government (2016) Carbon and Peatland 2016 Map [Online] Available at: https://map.environment.gov.scot/Soil_maps/?layer=10 (Accessed 17/12/2021)

¹³ BGS Geoindex [Online] Available at: <https://mapapps2.bgs.ac.uk/geoindex/home.html> (Accessed 17/12/2021)

¹⁴ BGS Geoindex [Online] Available at: <https://mapapps2.bgs.ac.uk/geoindex/home.html> (Accessed 17/12/2021)

Table 13.1 Framework for Determining Sensitivity of Receptors

Sensitivity of Receptor	Definition
Very High	<ul style="list-style-type: none"> The receptor has little or no ability to absorb change without fundamentally altering its present character, is of very high environmental value, or of international importance.
High	<ul style="list-style-type: none"> Soil type and associated land use are highly sensitive (e.g. peat/blanket bog); Class 1 or 2 priority peatland, carbon-rich and peaty soils cover >20% of the Proposed Development area; Receptor contains areas of regionally important economic mineral deposits.
Medium	<ul style="list-style-type: none"> Soil type and associated land use are moderately sensitive (e.g. commercial forestry); Class 1 or 2 priority peatland, carbon-rich and peaty soils cover <20% of the Proposed Development area; Class 3 and 5 peatland areas, carbon rich and peaty soils; Receptor contains areas of locally important economic mineral deposits.
Low	<ul style="list-style-type: none"> Soil type and associated land use not sensitive to change in hydrological regime (e.g. intensive grazing); Receptor contains Class -2, -1, 0, and 4 non-peatland areas, with no carbon-rich and/or peaty soils.
Negligible	<ul style="list-style-type: none"> The receptor is resistant to change and is of little environmental value.

Magnitude of Change

13.3.15 The magnitude of potential change will be identified through consideration of the Proposed Development, the degree of change to baseline conditions predicted as a result of the Proposed Development, the duration and reversibility of a change and professional judgement, good practice guidance and legislation.

13.3.16 The criteria for assessing the magnitude of change are presented in Table 13.2.

Table 13.2 Framework for Determining Magnitude of Change

Magnitude of Effects	Definition
High	<ul style="list-style-type: none"> Major or total loss of or alteration to peatland resource such that post development characteristics or quality will be fundamentally or irreversibly changed. Long term/permanent change to human or environmental health. Catastrophic failure of site infrastructure due to ground instability. Long term/permanent change to baseline resource. Major or total loss of a geological site or mineral deposit, where the value of the site would be severely affected.

Magnitude of Effects	Definition
Medium	<ul style="list-style-type: none"> Loss of, or alteration to the baseline resource such that post development characteristics or quality will be partially changed. Mid-term/permanent change to human or environmental health. Ground failure that requires remediation but does not cause catastrophic failure of site infrastructure. Mid-term/permanent change to baseline resource. Partial loss of a geological site or mineral deposit, with major effects to the settings, or where the value of the site would be affected.
Low	<ul style="list-style-type: none"> Small loss of soils or peatland, or where soils will be disturbed but the value not impacted. Short-term change to human or environmental health. Ground settlement/subsidence that does not adversely affect site infrastructure or require remedial action. Short-term change to baseline resource. Small effect on a geological site or mineral deposit, such that the value of the site would not be affected.
Negligible	<ul style="list-style-type: none"> Minimal or no change to soils or peatland deposits. Minimal or no change to human or environmental health. Minimal or no change to ground stability. A very slight change from the baseline conditions. The change is barely distinguishable, and approximates to the 'no-change' situation. Minimal or no change to a geological site or mineral deposit.

Significance of Effect

13.3.17 The sensitivity of the asset and the magnitude of the predicted effects will be used as a guide, in addition to professional judgement, to predict the significance of the likely effects. Table 13.3 summarises guideline criteria for assessing the significance of effects.

Table 13.3 Framework for Assessment of the Significance of Effects

Magnitude of Effect	Sensitivity of Resource or Receptor				
	Very High	High	Medium	Low	Negligible
High	Major	Major	Moderate	Moderate	Minor
Medium	Major	Moderate	Moderate	Minor	Negligible
Low	Moderate	Moderate	Minor	Negligible	Negligible
Negligible	Minor	Minor	Negligible	Negligible	Negligible

13.3.18 Effects predicted to be of major or moderate significance are considered to be 'significant' in the context of the EIA Regulations and are shaded in light grey in Table 13.3.

Contaminated Land Assessment

13.3.19 A contaminated land assessment has been undertaken in accordance with BS 10175 'Investigation of Potentially Contaminated Sites' and the desk-based research and site walkover have supported the development of a preliminary Conceptual Site Model.

13.3.20 The contamination risk at the site is discussed in further detail in Table 13.7, with the assessment considering the impact on the potential receptors at the site, including:

- Site users (end-user and personnel);
- The water environment; and
- Construction materials.

13.3.21 The risk assessment has been carried out adopting the Source-Pathway-Receptor assessment principle in line with guidance provided in CIRIA Report C552, "Contaminated Land Risk Assessment – a guide to good practice"¹⁵ as shown in Tables 13.4 and 13.5. Risk classification of moderate, high, or very high are considered to be significant in terms of EIA.

Table 13.4: Risk Classification Matrix

Likelihood	High Likelihood	Very High	High	Moderate	Moderate/Low
	Likely	High	Moderate	Moderate/Low	Low
	Low Likelihood	Moderate	Moderate/Low	Low	Very Low
	Unlikely	Moderate/Low	Low	Very Low	Very Low
		Severe	Medium	Mild	Minor
		Consequence			

¹⁵ Construction Industry Research and Information Association (CIRIA) (2001) Contaminated land risk assessment. A guide to good practice (C552). CIRIA: London (Accessed 13/10/2020)

Table 13.5: Risk Classification Definition

Risk Classification	Definition
Very High	Avoid project development at these locations.
High	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short term and are likely over the longer term.
Moderate	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild. Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer term.
Moderate/Low	
Low	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.
Very Low	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.

Assessment Limitations

- 13.3.22 There were no assessment limitations encountered during the course of the Study relating to geology, soils and peat.

13.4 Scoping Responses and Consultation

- 13.4.1 Throughout the scoping exercise, and subsequently during the ongoing EIA process, relevant organisations were contacted with regards to the Proposed Development. There were no consultation responses received in relation to Geology & Peat.

13.5 Baseline Conditions

- 13.5.1 The Site is located adjacent to the Existing Wind Farm in the east and occupies undulating farmland in the western and south eastern areas, whilst commercial forestry occupies the central and north eastern Site areas. The Site rises from approximately 175 m Above Ordnance Datum (AOD) in the east to approximately 200 m AOD in the west. The existing on-site farming and forestry operations will continue throughout the construction and operation of the Proposed Development, with localised forestry felling proposed to allow the advancement of proposed turbines and associated infrastructure.
- 13.5.2 The wider context of the Site is in close proximity to the M8 motorway and adjacent to the Harthill services; beyond the immediate surrounding area there are a series of residential areas including Blackridge, Harthill and Armadale.

Superficial Soils

- 13.5.3 Published geological mapping of superficial soils indicates the majority of the Site to be underlain by Devensian Till with small areas consisting of peat or being unrecorded. Peat is a partially decomposed mass of semi-carbonized vegetation which has grown under waterlogged, anaerobic conditions, usually in bogs or swamps. There is one large pocket of peat in the centre of the Site. Figure 13.2 illustrates the Superficial Soils Map.

Bedrock Geology

- 13.5.4 Published bedrock geology mapping indicates the Site to be underlain by various rock types. The entirety of the Site is underlain by the Scottish Lower Coal Measures Foundation comprising sedimentary rocks sandstone, siltstone and mudstone in repeated cycles that most commonly coarsen upwards, but also fine upwards locally, with seatclay or seatearth and coal at the top.
- 13.5.5 The mudstone and siltstone are usually grey to black, while the sandstone is fine- to medium-grained and off-white to grey. Coal seams are common and many exceed 0.3 m in thickness. Figure 13.3 illustrates the Bedrock Geology.

National Soils of Scotland

- 13.5.6 The following is a summary of the information on soil units from Scotland's Soils, Scotland's Environment Website¹⁶.
- 13.5.7 National Soils Map of Scotland mapping indicates the majority of the Site, can be characterised by the soils group 'Brown Soils' and 'Mineral Gleys'. 'Brown Soils' are characterised as moderately acid soils with brown mineral topsoils and brown or yellowish subsoils. 'Mineral Gleys' are soils characterised as noncalcareous gleys which can be found in undulating lowlands with gentle and strong slopes. Gleys are soils that are periodically or permanently waterlogged. Figure 13.4 'National Soils Map of Scotland' illustrates the soils underlain within the Site boundary.

Carbon Rich Soils and Peat

- 13.5.8 Peat is a sedimentary material, which is dark brown or black in colour and comprises partially decomposed remains of plants and organic materials preserved in anaerobic conditions, essentially within a waterlogged environment. There are two principal types of peat:
- Acrotelm is the upper layer, quite fibrous and contains plant roots. Acrotelmic peat is relatively dry, generally lying above the groundwater table and has some tensile strength; and
 - Catotelm is the lower layer of peat, highly amorphous and has a very high water content, generally lying below the ground water table and has a very low tensile strength.
- 13.5.9 The Carbon and Peatland Map¹⁷ indicates the absence of carbon-rich soils and peatland across the majority of the Site, with only two isolated pockets of Class 5 soils recorded at the eastern and western Site boundaries. Class 5 soils are described as 'peat soil' with no peatland vegetation. The extent of the

¹⁶ Scotland's Environment (2020) Scotland's Soils. Available at: <http://soils.environment.gov.scot/> (Accessed 12/05/22)

¹⁷ Scotland's Environment (2020) Scotland's Soils, Carbon and Peatland 2016 Map. Available at: <https://soils.environment.gov.scot/maps/thematic-maps/carbon-and-peatland-2016-map/> (Accessed 12/05/2022)

Class 5 soils at the Site are presented in Figure 13.5 'Extract from Carbon and Peatland 2016'.

- 13.5.10 Although online mapping records Class 5 soils on the Site, it should be noted that no significant peat deposits were recorded during the Phase 1 peat probing undertaken at the Site, with a maximum peat depth of 0.6 m recorded in the areas of Class 5 soils, as detailed in Field Surveys below.

Field Surveys

- 13.5.11 The desk-based assessment recorded the potential presence of peat and peaty soils in line with SNH data described in Section 13.5.9. The results of the peat probing indicated that peat was generally absent across the Site, with no significant deep deposits recorded on the Site.
- 13.5.12 During the Phase 1 survey, a total of 102 probes were sunk across the Site with 98% recording peat at depths less than 0.5 m and the vast majority recording no peat. The deepest peat recorded on site was 0.6 m deep.
- 13.5.13 Recorded peat depths averaged 0.03 m as displayed in Table 13.6, while the peat probe locations and interpolated depths are shown in Figure 13.6.

Table 13.6: Peat Depth Summary

Peat Depth Range (m)	Number of peat probes	Percentage of Total (%)
0.01 - 0.50 m	100	98.03
0.51m - 1.00 m	2	1.97
Total	102	100.00

Coal Mining

- 13.5.14 A review of the Coal Authority Interactive Map Viewer¹⁸ confirms that the Site is extensively underlain by historical mine workings from underground extraction. A number of surface features have also been identified including remnants of mine workings.
- 13.5.15 The Coal Authority Interactive Map Viewer confirmed that there are no shafts or adits recorded within the Site. There are four mine shafts and two adits located in close proximity to the north of the Site. It should also be noted that there remains a possibility that further mine entries may exist on the Site which are not recorded.
- 13.5.16 The Coal Mining Authority reports that the majority of the Site is located in a development high risk area. Past shallow coal mine workings and probable shallow coal mine workings are recorded on the Site.
- 13.5.17 A Coal Mining Risk Assessment (CMRA) was completed by Wardell Armstrong in July 2022 and is included as Technical Appendix A13.1 in this EIA Report. The CMRA identified:
- the presence of geological faulting adjacent to the proposed locations of T1 and T2,

¹⁸ The Coal Authority (2020) Coal Authority Interactive Map Viewer. Available at: <https://mapapps2.bgs.ac.uk/coalauthority/home.html> (Accessed 17/05/2022)

- the presence of probable unrecorded shallow workings (close to T1 and T2),
- the presence of recorded shallow mine workings present beneath turbines T3 and T4, and
- the presence of recorded mine workings between depths of 40 m and 500 m on the Site.

13.5.18 The CMRA recommended a targeted site investigation in order to better inform the assessment of shallow mining risk. Should the investigation deem it a requirement, a programme of ground treatment works by drilling and pressure grouting would have to be undertaken prior to construction of the Proposed Development, or the turbine locations adjusted to avoid areas of ground instability.

13.5.19 Furthermore, during soil stripping, excavation for foundations, etc., the earthworks contractor must examine the ground for any signs of unrecorded mine entries in the site area. If signs of mine entries are detected, then investigation and stabilisation of the mine entry will need to be undertaken.

Contaminated Land

13.5.20 There is potential for contaminated land to be present at the Site, associated with former mining activities at the Site. Underground mining is recorded to have taken place on the Site up to 1976, with the Coal Authority also stating the possibility for unrecorded shallow mine workings and / or mine entries to be present within the eastern Site area.

13.5.21 Ground investigation should be undertaken in conjunction with the coal mining site investigation to determine the presence of any potential contaminative sources and to allow for a suite of chemical testing to determine ground conditions and the presence of any contamination.

13.5.22 Site personnel should wear appropriate PPE during all works. this may include hand protection along with the provision of adequate welfare facilities and dust control measures, as required.

13.6 Assessment of Potential Effects

13.6.1 The effect of the Proposed Development on soils and geological receptors has been considered for the construction, operation and decommissioning phases.

Soils and Peat

13.6.2 Construction activities with the potential to disturb peat includes the excavation of soils to enable the construction of the following infrastructure:

- Turbine foundations;
- Track alignments;
- Crane hardstandings; and
- Associated infrastructure, such as substation and construction compounds.

- 13.6.3 There are no potential effects during the operations and decommissioning phases of the Project.
- 13.6.4 There were no significant peat deposits recorded on the Site, therefore no significant peat disturbance will take place during the construction of the Proposed Development.
- 13.6.5 On this basis, in the absence of mitigation, the Proposed Development is considered to result in a potential effect of **negligible** significance on peatland across the Site and is **not significant** in terms of the EIA Regulations.

Coal Mining

- 13.6.6 The Coal Authority operates a risk-based approach to the assessment of potential instability issues associated with future development of land located within the predefined Coal Authority consultation areas. This risk-based approach subdivides the potential risk into "low" and "high" risk categories.
- 13.6.7 The risk categories can be defined as:
- 13.6.8 **Low-Risk Sites** – Deemed to be land where coal mining has taken place, however it was at such depth not to pose a risk to new development and it therefore contains no known recorded risks and as such no further assessment is required.
- 13.6.9 **High-Risk Sites** – Deemed to be landholdings located within an area known to contain legacy risks that include:
- Mine entries (shaft or adit);
 - Shallow coal workings (recorded and probable);
 - Workable coal seam outcrops;
 - Mine gas sites and areas;
 - Recorded coal-mining-related hazards;
 - Geological features (fissures and break lines); and/or
 - Former surface mining sites (sometimes using historic opencast extraction methods).
- 13.6.10 Coal mining records for the Site indicate the presence of a majority of the above listed legacy risks which would deem the Site to be at high risk from potential instability issues as classified by the Coal Authority.
- 13.6.11 Where possible, risk has been reduced by locating turbines and Site infrastructure in areas unaffected by known historic mining activities.
- 13.6.12 As previously stated, a CMRA for the Site has been undertaken by Wardell Armstrong and is included within Technical Appendix A13.1. The assessment indicates that the Site is extensively underlain by historical mine workings from underground extraction. A number of surface features have also been identified including remnants of mine workings.
- 13.6.13 Turbines are at particular risk from mine workings. If a worked shallow seam were to collapse, it is possible that ground movements could be propagated to the surface. If these movements were sufficiently large, then it may cause excessive settlements, loss of stiffness or loss of bearing capacity. This may result in catastrophic failure of the turbine foundations and ultimately the turbine.

- 13.6.14 The findings of the CMRA conclude that the risk to the Proposed Development from mining is of significant risk. Mitigation has been implemented through the design process to avoid known mining features; however, there is potential for unrecorded shallow mining to be present at the Site, which cannot be confirmed until site investigation has taken place. On this basis, the Proposed Development remains a High-Risk Site in terms of coal mining risk, which would be considered to pose a potentially **major** significance of effect and therefore **significant** in terms of the EIA Regulations.
- 13.6.15 Following the completion of pre-construction site investigation and any subsequent remedial action deemed necessary, it is considered that the significance of effect will be reduced to **minor** and therefore **not significant** in terms of the EIA Regulations.

Contaminated Land

- 13.6.16 A Contaminated Land Risk Assessment for the Site is presented in Table 13.7. This details the potential connectivity between potential sources, pathways, and receptors. A pathway must be present for the source to provide any risk to any given receptor. The magnitude of any such risk is assessed by considering the vulnerability of the receptor and the possible impact of the source.

Table 13.7 – Contaminated Land Risk assessment and Potential Mitigation

Potential Receptor	Potential Source	Potential Pathway	Consequence of Risk	Likelihood of Risk	Level of Risk (without Mitigation)	Potential Mitigation
Site Personnel	Made Ground or contaminated soil associated with historical coal mining.	Direct dermal contact/ingestion/inhalation of soil/water/dust and vapours.	Medium	Low Likelihood	Moderate/Low	Ground investigation should be undertaken at the Site to allow for a suite of chemical testing to determine ground conditions and the presence of any contamination. Site personnel should wear appropriate PPE during all works. this may include hand protection along with the provision of adequate welfare facilities and dust control measures, as required.
	Groundwater contamination associated with historical mining activities.					
	Ground gases associated with former coal mining.	Exposure to ground generating gases such as carbon dioxide, hydrogen sulphide, methane or depleted oxygen.	Medium	Low Likelihood	Moderate/Low	Ground investigation should be undertaken to determine ground conditions on the Site and to allow for the installation of gas monitoring wells to enable a period of ground gas monitoring in accordance with CIRIA 665 to classify the ground gas risk at the Site.
Water Environment	Contamination in groundwater from contaminated soils.	Vertical or lateral migration of contaminants to surface watercourses and underlying aquifers.	Medium	Low Likelihood	Moderate/Low	Leachate analysis should be included within the chemical testing of Made Ground deposits to determine the leachability of any contaminants. A series of groundwater monitoring wells should be advanced to allow for groundwater sampling.
Construction Materials	Elevated contamination aggressive/corrosive to proposed construction materials.	Exposure to elevated pH and/or sulphates or other corrosive contaminants through soil infiltration to buried concrete.	Medium	Low Likelihood	Moderate/Low	Ground investigation should be undertaken at the Site to allow for a suite of chemical testing to determine ground conditions and chemical composition of the soils.

- 13.6.17 It is considered that there is low likelihood of construction personnel becoming exposed to soil or groundwater contamination during excavations or construction at the Site where concentrations of contaminants exceed generic assessment criteria, and risk to construction workers is classified as moderate/low. Ground investigation will be required to determine the presence of any contaminants at the Site and inform any required remedial action.
- 13.6.18 Risk to Site end-users (maintenance personnel) being exposed to soil contamination is classified as low given that only sporadic visits by maintenance personnel is anticipated and operational groundworks will be limited. Similarly, the risk to Site end-users from ground gas is considered low given the lack of development on the Site other than the substation building which will only be occupied for short periods of time.
- 13.6.19 The bedrock is classified as a moderately productive aquifer, where nearly all flow of groundwater is in the near-surface weathered zone and secondary fractures. It is considered that there is low likelihood of the water environment being exposed to contaminants as a result of the Proposed Development. Ground investigation prior to the construction stage will identify the presence of any unknown mining features and allow for leachate and groundwater sampling, as required, to ensure that the Proposed Development does not result in the mobilisation of contaminants to the water environment. In the absence of mitigation, risk to the water environment is classified as moderate/low.
- 13.6.20 The construction materials proposed for use in the Proposed Development have a low likelihood of coming into contact with aggressive ground conditions, such as elevated pH or sulphates, or contamination from infilled Made Ground. It is therefore considered that the risk posed to building materials on Site is classified as moderate/low.
- 13.6.21 On this basis, in the absence of mitigation, the moderate/low risk identified at the Site is considered to result in the potential for significant effect in accordance with the EIA Regulations. Mitigation to reduce all risk is presented in Section 13.10.
- 13.6.22 Following pre-construction ground investigation and the implementation of any remedial actions to mitigate any identified risks, a resulting very low risk would remain, which is considered to be a negligible significance of effect and therefore not significant in terms of the EIA Regulations.

Operational Phase

- 13.6.23 There would be minimal or no impacts upon peat and soils during the operational phase, including contaminated land, and significant effects are not anticipated.

Decommissioning Phase

- 13.6.24 During decommissioning, the bases would be broken out to below ground level. All cables would be cut off below ground level, de-energised, and left in the ground. Access tracks would be left for use by the landowner. No stone would be removed from the Site. The decommissioning works are estimated to take six months. This approach is considered to be less environmentally damaging than seeking to remove foundations, cables, and roads entirely

13.6.25 Therefore, it is considered that decommissioning activities would be less intrusive and would not disturb peat, therefore no significant effects are anticipated.

13.7 Assessment of Cumulative Effects

13.7.1 Geology, soils and peat are considered as site-specific considerations and it is not considered that there will be cumulative effects. Similarly potential significant effects from historical mining identified are specific to the Proposed Development with no implications for cumulative effects.

13.8 Mitigation Measures

- 13.8.1 Peat was not recorded at any significant depth across the Site, however if any should be encountered, good practice measures will be implemented. Good practice drainage measures are set out in Appendix A14.1: Outline Water Construction Environmental Management Plan (Chapter 14 – Hydrology and Hydrogeology) significantly reducing the impact on peat and peaty soils.
- 13.8.2 Maintenance of existing drainage is critical to maintain existing groundwater levels and existing moisture content within soils to avoid potential compaction of soils resulting from construction activities. Therefore, all existing drainage network channels would be maintained and, where necessary, channelled below the access track construction drainage ditches on the upslope of the track.
- 13.8.3 Targeted site investigations will be undertaken pre-construction at the location of proposed site infrastructure and at turbine locations following forest clearance, to determine more details on soils, geology and potential contamination, as well as to determine the presence of any unrecorded mining activities. Should the site investigations identify the presence of unrecorded coal mining and / or contamination with the potential to impact the Proposed Development, a programme of ground treatment works by drilling and pressure grouting and / or remediation would have to be undertaken prior to construction of the Proposed Development, or the turbine locations adjusted to avoid areas of ground instability and contamination.
- 13.8.4 A micrositing allowance of 50 m is being sought as part of the application to support this process. This allowance has been included within the EIA assessment process. This is required to be secured by planning conditions in line with the assessment and the Coal Authority response at Scoping.
- 13.8.5 Should the 50 m micrositing not achieve a relocation of turbines and associated infrastructure into a lower risk area in relation to underlying mining, further mitigation would be required, informed by the ground investigations scheme. This could include, but not be limited to, the following circumstances and related mitigation:
- Turbine is located in an extensive areas of development risk from shallow underground mining – Mine Working Consolidation would be required beneath the area of the turbine and associated infrastructure by injection of a cement-based grout.

13.9 Residual Effects

- 13.9.1 In relation to effects identified through the CMRA, the Proposed Development would be designed and constructed in line with findings of the detailed ground investigation to be secured through a planning condition. Through this process, the potential for significant effect on the Proposed Development infrastructure would be removed through appropriate mitigation.
- 13.9.2 Following the implementation of mitigation measures as detailed in Table 13.7, the significance of impact would be reduced such that the residual effects associated with contaminated land will be not significant in accordance with the EIA Regulations.

13.10 Summary

- 13.10.1 This Chapter identified no likely residual significant effects, through inclusion of the measures as outlined in Table 13.7.

Table 13.7: Summary of Effects

Receptor	Potential Effect	Significance of Effect	Mitigation Proposed	Residual Significance
Construction				
Peat and Peaty Soils	Affect carbon-rich and peaty soils; Disturbance to an area <20% of the Proposed Development Area, the presence of class 5 peatland areas (carbon rich and peaty soils) Affecting commercial forestry	Negligible	None – No significant peat deposits are present at the Site.	Negligible
Contaminated Land	Exposure of contaminated materials to Site personnel as a result of historic land use at the Site	Moderate/Low	Ground investigations being carried out pre-construction should consider the potential for contaminated land. Where a contaminative risk is identified, subsequent remediation may be required. Vigilance should be maintained throughout the construction period to identify any potential unrecorded contamination.	Negligible

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Receptor	Potential Effect	Significance of Effect	Mitigation Proposed	Residual Significance
			Site personnel should use appropriate PPE.	
Mining	Ground settlement and loss of bearing capacity may lead to collapse and failure of turbine	Major	<p>Pre-construction intrusive ground investigation and associated mitigation to inform detailed design of foundations and present a viable development, respectively.</p> <p>Vigilance should be maintained throughout the construction period to identify any potential unrecorded mining features. Mining specialist should be appointed to provide technical support post-consent.</p> <p>Additional mitigation based on results of pre-construction ground investigations could include consolidation of abandoned mine workings and unrecorded mine entries, through a programme of ground treatment works by drilling and pressure grouting.</p>	Minor

Statement of Significance

- 13.10.2 This Chapter has assessed the likely significance of effects relating to the Proposed Development on geology, soils and peat. Additionally, the Chapter has considered the potential for effects of contaminated land on construction personnel and the potential for the impact of historical mining on the Proposed Development infrastructure.
- 13.10.3 The CMRA has identified the potential for a significant effect from historic mining before mitigation. Following detailed site investigations to be undertaken pre-construction, the Site design will be reviewed to ensure no potential significant risks remain to the infrastructure or turbines. Pending detailed ground investigation, a micro-siting allowance of 50 m to the known mining features, which has been assessed as part of this EIA, has been requested to support this process.
- 13.10.4 With the incorporation of mitigation measures as detailed in Table 13.7, the risk would be reduced such that the residual effects associated with contaminated land will be **not significant** in accordance with the EIA Regulations.