Technical Appendix 10.4:

Outline Peat Management Plan

Carnbuck Wind Farm

Peat Management Plan

31 March 2022

1277447

For Planning

Renewable Energy Systems

Document history

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1. Introduction

The Peat Management Plan (PMP) provides guidance on the re-use and management of excavated peat across the proposed Carnbuck Wind Farm (the Proposed Development).

The information presented in this plan should be used to inform the wider assessments carried out for the Proposed Development. The study has drawn on information collected as part of peat studies including a desk study followed by a phase one then detailed peat probing exercise. The PMP as outlined in this document; estimates the total volumes of excavated peat likely to be produced by the Proposed Development and outlines suitable reuse methods in line with regulatory requirements and best practice construction methods.

This strategy should be adopted to ensure peat is managed in a sustainable manner, minimising excavation via the adoption of appropriate construction methods. Targeted re-use of peat as part of the reinstatement works shall also be a primary consideration.

Reporting Team

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1.1. Regulatory Requirements

This document addresses the following requirements in line with statutory guidance of the UK:

- **Prevention** – The best management option for waste peat is to prevent its production; and
- **Re-use** – Developers should attempt to re-use as much of the peat produced on site as possible.

In general, the following guidance has fed into the design assumptions and subsequent selection of appropriate construction methods based on the distribution of peat depths across the site:

- Developments on Peatland: Guidance on the assessment of peat volumes, re-use of excavated peat and the minimisation of waste (A joint publication by Scottish Renewables, Scottish Natural Heritage (SNH), SEPA, Forestry Commission Scotland, 2012);
- Floating Roads on Peat (Forestry Civil Engineering & SNH, 2010); and
- Good Practice During Wind Farm Construction (A joint publication by Scottish Renewables, SNH, SEPA, Forestry Commission Scotland, 2019), Version 4.
- Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments (Energy Consents Unit, Scottish Government, 2017), Second Edition.

1.2. Limitations

The information presented in this report is based on the results of peat surveys carried out by Natural Power in February 2019. Detailed probing has been subsequently undertaken in January 2020 following a confirmed site layout. Further layout updates were communicated in March 2022 after which a final phase of detailed peat probing was undertaken.

It is highlighted that whilst attempts have been made to collect peat depth and condition information, further investigations should be carried out as part of detailed site investigation (pre-construction). This process will provide further detailed design information across all infrastructure locations, which should be used to refine the peat excavation and reuse volumes provided in this report.

The PMP should be considered as a 'live' document throughout the planning and any future pre-construction phases of works. As such, additional information can be incorporated following the results of detailed site investigations carried out prior to construction as well as from any discussions with engaged stakeholders throughout the development process.

2. Site Context

The following section presents a summary of the development. This report should be read in conjunction with the Peat Slide Risk Assessment (Doc No. 121817) that provides further assessment of peatland conditions on site.

2.1. Description of Development

The development will comprise of up to 12 wind turbine generators. Wind farm infrastructure will also be required in the form of external wind turbine transformer housings, crane hardstand areas, substation, underground electricity cables between the turbines, associated access tracks, water crossings and drainage attenuation measures as necessary. A full development description of the 'Proposed Development' is provided in ES Volume 2 Chapter 1: Introduction and Description of Development.

The Proposed Development is located on upland terrain dominated in the north by the existing Gruig Windfarm and to the south by Skerry Hill (511m AOD). Access onto the development is via a gate at the entrance to the existing Gruig Windfarm at Irish Grid Reference [313248, 421711]. Figure 2.1 shows the site layout and associated infrastructure, and Figure 2.2 shows the regional setting.

Source: RES, OpenStreet Map

Figure 2.1: Site Layout – Carnbuck Wind Farm

Source: RES, OpenStreet Map

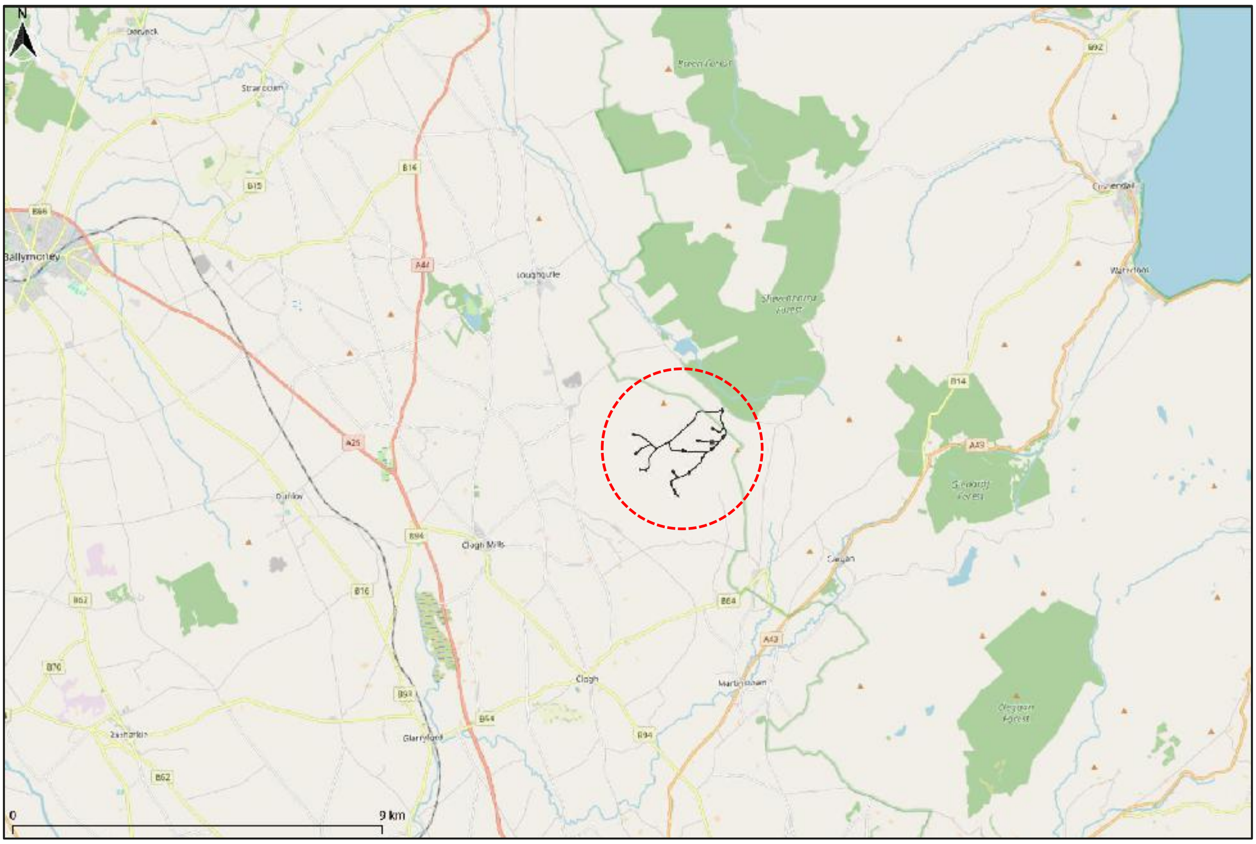


Figure 2.2: Regional Setting – Carnbuck Wind Farm

2.2. Hydrology

Information on the Northern Irish Rivers Agency interactive viewer[1] indicates numerous minor streams and associated surface water across the development; this is confirmed from observations made during the peat survey. The streams initiate as wet flushes within topographic basins and depressions at the higher elevations of the development. As watercourses flow down the main slopes they are confined to deeply incised channels which have been cut into the peat. These streams confluence into a larger watercourse at the centre of the development. This then flows in a south westerly direction and off the development.

Base flow is provided to the streams and lower areas by peat deposits at the top of the development. Drainage of the ground appears to be limited as much of the ground is saturated. Artificial drains have been excavated across the site by the landowners to provide additional drainage.

2.3. Soils and Peat

The generalised soil type according to the Soils of Northern Ireland Map within the Proposed Development is 'Histosol', this is categorised as a soil with thick organic layers. This is in line with the peat surveys conducted on site.

[1] https://www.azimap.com/explore/view/13

Blanket bog / peatland is identified across the lower slopes of Skerry Hill. Where low peat depths were identified the peat coring has indicated that depths below 0.50m are generally organic rich silty clays. Glacial Till is identified on the GSNI 1:50,000 superficial geology map.

2.4. Hydrogeology

Plateau basalts underly the main development are classified by the British Geological Surveys as a moderately productive aquifer, with yields ranging from 0.5 to 20 L/s with typical rates around 5 to 10 L/s. ground water movement is confined to fractures within the rock, rather than intergranular flow.

The sedimentary rocks under the plateau basalts are classified as highly productive aquifers, which is a regionally important aquifer up to 150m thick. Due to the karstic characteristics of the limestones, the flow is confined to relatively large fractured pathways allowing yields at springs of up to 32 L/s, yields in boreholes are typically less, around 5 L/s.

The solid geology, as shown on Figure A.5 (Drawing reference: GB201993_M_002_D), shows lower basalt formation to be present under all infrastructure locations. Care should be taken when any future drilling is carried out across the development with caution not to breach this boundary unless necessary and with suitable aquifer protection measures in place. Depth of basaltic formation is unknown therefore drilling within this geological unit should be minimised where possible. Tooling, materials, and expertise within the drilling team for managing artesian water should be present on site when drilling within the bedrock formation.

3. Peat Survey Results

Surveys have been carried out to investigate peat depth and extent across the site. Peat depth information has been collated to support the volumetric calculations provided in this document and has subsequently been used to consider and minimise any potential impact on the peatland environment.

Investigations were undertaken to ensure a high resolution and focussed assessment maximises the understanding of the impacts of the project on the local peatland environment by improving the efficacy of the volumetric calculations provided in this document. The completion of a focussed assessment also provides the greatest opportunity to microsite infrastructure away from areas of deeper peat.

Peat deposits can exist in one of three forms:

- Fibrous – non-plastic with a firm structure and is only slightly altered by decomposition;
- Pseudo-fibrous – peat in this form still has a fibrous appearance but is much softer and more plastic than fibrous peat. The change is due to more prolonged sub-mergence in airless water rather than to decomposition; and
- Amorphous – decomposition has destroyed the original fibrous vegetation structure such that it has virtually become organic clay.

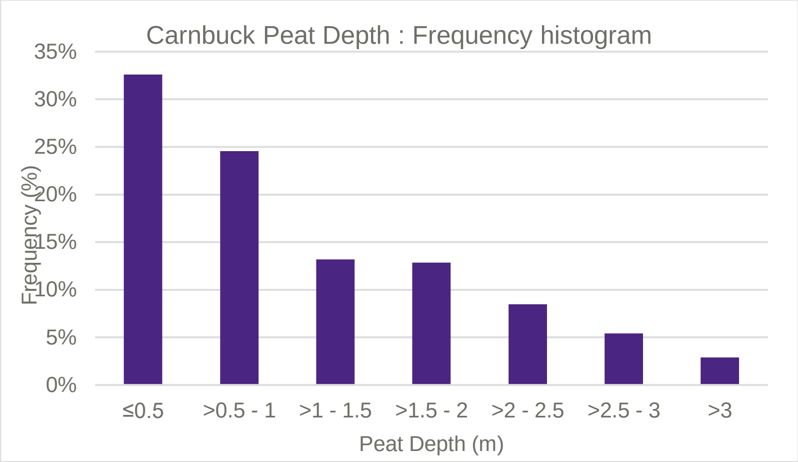
Peat deposits can also be characterised into two layers:

- The 'acrotelm' is the upper layer and has a relatively high hydraulic conductivity and therefore has variable water content. This layer comprises of a thin surface layer of active vegetation; and
- The 'catotelm' is the lower layer, permanently below the water table, which has a small hydraulic conductivity and is often at a higher state of humification and lower tensile capacity.

In total, 1,640 locations were surveyed for peat depth across the preliminary site boundary. The surveys consisted of phase 1 peat depth investigations within the preliminary site boundary across a 100m grid. A phase two survey with 50 m centrelines and 10m offset of tracks and 20m of turbines and the collection of peat cores at selected turbines with deeper peat and geotechnical information at all turbines and other key infrastructure locations.

Figure 3.1 provides a summary of the peat depths recorded during the initial phase of peat survey and an interpolated peat depth map Figure A.1 shows the distribution of peat depths in relation to infrastructure elements and the preliminary site boundary.

Figure 3.1: Peat Depth Frequency Phase 1 Surveys



Source: Natural Power

Figure 3.1 shows that the highest proportion (37%) of recorded peat depths fell within the ≤0.5 m range, with the next highest proportion (23%) within the >0.5 – 1.0 range. The areas of deep peat (greater than 1.0 m) are confined to the northeastern quadrant of the proposed development.

Peat depth measurements of less than 0.5 m have been categorised as peaty soils, with deep peat deposits being >1.0 m in depth. Therefore, where depths are less than 0.5 m, these will be excluded from final peat excavation calculations.

Source: Natural Power

Figure 3.2: Extract Figure A1 – Peat Depth Map – Purple track sections indicate floating type

4. Peat Excavation and Re-Use

In order to quantify the volume of peat that may be excavated and re-used across the Proposed Development, the proposed wind farm layout has been analysed using the comprehensive peat depth dataset. The proposed 12 wind turbine layout has been appraised to obtain a preliminary estimate of the size and extent of the infrastructure footprint.

The volumetric analysis of excavated peat volumes incorporates the mean peat depths recorded across each infrastructure element. Average peat depths have been assessed based on relevant interpolated data points.

The estimation of peat extraction and re-use volumes relies on a series of design assumptions that may vary on a small scale according to discrete changes in ground conditions. Therefore, it should be highlighted that the peat volume estimates stated in this report are a preliminary indication only.

Volumetric calculations should be re-evaluated if more detailed intrusive site investigation data becomes available. Design assumptions for the access track construction methods have also been taken. The design of the detailed site layout should be confirmed with a comprehensive site investigation.

4.1. Design Assumptions

Excavation & Replacement

Excavate and replacement ('cut') type construction of tracks, passing places, turning areas and crane pads are proposed where peat depths are consistently shallower than 1.0 m, along section of access track and/or where gradients are in excess of 1:10. This type of construction may also be adopted where there are cross slopes to be negotiated. The cut and fill construction method require the removal of peat deposits down to a suitable sub-grade layer within the superficial or bedrock geology. Excavated peat is then reinstated carefully along access track landscaped verges on either side of the track or utilised in appropriate landscaping across the development.

Excavate and replacement track construction sequences shall be designed in accordance with local ground conditions and following a detailed site investigation. A general good practice construction sequence has been provided below and has been adapted and informed by best practice guidance:

1. The route of the cut / fill access track shall be marked out on the ground well ahead of the construction activity. This will allow for advanced checks of any newly developed or unforeseen constraints;
2. As part of this process, the most sensitive sections of the access track route shall be defined. This will include water crossings, peat hags, slopes and steep slopes. These defined zones shall become established management zones where specific mitigation measures and construction techniques shall be implemented to minimise impacts during the construction phase;
3. Where possible, the construction of the cut tracks shall avoid periods of wet weather (when peat deposits are particularly susceptible to deformation and when there is an increased risk of run-off carrying unacceptable levels of sediment. Similarly, the construction of access tracks shall, where possible, avoid periods of very dry weather; when there is a high risk of excavated and exposed peat soils drying out;
4. The cut access track construction shall typically proceed in an uphill direction, thus allowing drainage to be managed with a greater degree of control. The access track side and cut-off ditches shall generally be constructed first. It shall be ensured that these discharge to a suitable buffered watercourse in line with the hydrological assessment and relevant drainage controls. It shall be important to ensure that surface water run-off is directed away from the track formation layer. This will act to reduce disturbance by the prevention of water-logging and erosion;
5. A progressive construction method shall typically be adopted whereby the cut track is excavated to a suitable formation and up-filled to the track running surface. Following this, the newly constructed track verges will be restored with peat and vegetation from the next advancing section of track under construction. The sequence of

excavation, up-fill and restoration will be managed to minimise the time between excavation and restoration as far as is practicable; and

6. Plant machinery shall work where practicable from the section of access track most recently completed. The re-use of peat turves and peat from newly excavated sections onto the verges of the most recently completed section of track will act to reduce the overall disturbance of excavated peat. Excavators with long reach arms are also beneficial in reducing vehicle manoeuvres over peat deposits.

Floating Construction

Floating construction of tracks, passing places and turning areas is proposed where peat depths are consistently deeper than 0.5 m and where slope geometry is acceptable. An example construction sequence for floating roads adapted from the publication is provided below. This sequence of construction may need to be adapted to localised ground conditions, which may only become fully evident following a detailed site investigation:

1. Mark out the alignment of the road and install advance drainage ahead of construction where necessary;
2. Clear the intended floating road area of major protrusions such as rocks, trees, and scrub vegetation down to ground level leaving any residual stumps and roots in place;
3. Leave the local surface vegetation and soils in place if possible. In many cases the existing vegetation and root system may be the strongest layer in the soil system providing increased tensile strength at surface, and care shall be taken to preserve the integrity of this layer;
4. Any local hollows or depressions along the route alignment shall be infilled with a suitable lightweight fill such as tree brash, logs or a combination of lightweight fill and suitable materials. Similarly, a brash mat and fascines (bundles of brash material) may be adopted to form the initial surface across uneven ground surface;
5. Broken vegetation surfaces such as peat hags and very wet areas with high fines content, may need to be covered with a separator grade geo-membrane to prevent contamination of the aggregate layers. This geotextile may be covered with a thin regulating layer of aggregate prior to installing the main geo-grid;
6. Geo-grids are placed by hand along the alignment of the road, directly onto the prepared area with a simple overlapping arrangement generally in accordance with the relevant manufacturer's specification. A minimum transverse overlap is normally set at 400 mm. However, this may need to be increased depending on the amount of displacement and transverse tension caused by un-even terrain. This should be specified by the geo-grid manufacturer;
7. Place the first layer of aggregate material onto the geo-grid, this shall be a suitable 'well graded material' that will be able to achieve a sound interlock with the geo-grid. The final specification of the aggregate grading shall be dictated by the chosen geo-grid mesh size. Care shall always be taken to avoid damage to the geo-grids; and
8. The degree of compaction required will be dictated by the local ground conditions along the route alignment. Across exceptionally soft areas of peat there may be a requirement not to apply mechanical vibratory compaction and instead rely on compaction of aggregate through trafficking of wheels and tracks of the construction plant alone.

Cut track has been specified adjacent to the main turbine infrastructure within the floating track.

Access Track Dimensions

Proposed new cut and floating access tracks have been assumed to accommodate an 5m running width, with drainage making up an additional 2m, giving a total width of 9 m. The peat volume calculations have assumed a 9m wide access track excavation with a batter angle of 45^{o} to the excavation sides. This geometry includes the additional width of 1 m along either side of the track to accommodate drainage and cabling. See figure 4.1 for the access track geometry used for the cut track peat volume calculations. All peat excavated outside of the 9m total width is to be reinstated or used to profile the track and so Is not considered waste.

Electrical cabling is typically laid in trenches (0.5 m width) adjacent to the access track network, which requires excavation, laying and backfilling. Peat generated from cable trenching is normally replaced at its point of origin and is therefore not considered as an excavation loss.

Source: Natural Power

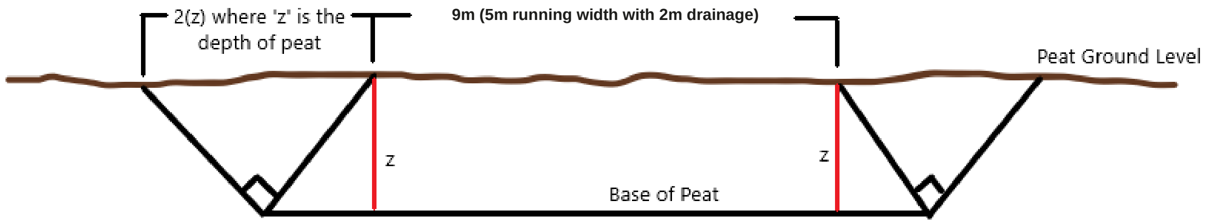


Figure 4.1: 'Cut' access track dimensions used for calculations

Turbine Foundations

During turbine construction, peat is generated by excavation to the substrate to accommodate the concrete foundation and for a working area surrounding the foundation footprint. The surface working area of the wind turbine foundation excavation has been assumed to be a total excavation area of 639 m^2 into which a reinforced concrete gravity base will be constructed.

It should be noted that although excavation areas for crane pad areas and foundations will likely overlap, to provide a conservative assessment, peat volumes are calculated for both areas separately.

Crane Pads and Hardstands

The hardstand will be 35m in width and 55m in length equating to a permanent land take of 1,925m^2 and is the value which is used for excavation volume calculation. Additional excavation will be required for laydown areas. which are not included as part of this assessment as these areas will typically be of a floated type construction without the need for excavation.

Additional and Ancillary Infrastructure

The proposed ancillary infrastructure associated with the Proposed Development consists of an energy storage construction compound, a control building and a control building hardstanding.

The estimations of the excavated peat volumes and any subsequent reinstatement have been calculated based on the design information available at the time of writing:

- 1 x Energy Storage Construction Compound: 45m x 100m (4,500m^2);
- 1 x Control Building 85m x 37m & 1 x Substation hardstanding 9m x 20m: (3,400m^2);

4.2. Excavation Volumes

The estimate of excavated peat volume has been completed following a desk-based appraisal of the proposed wind farm layout supplemented by digital terrain analysis. There has been further refined spatial analysis of the peat depth data set using GIS software. According to latest statutory guidance peat soil is an organic soil which contains more than 60 per cent of organic matter and exceeds 50 centimetres in thickness. Therefore, for the purposes of these calculations, and because of the information collected on site, depths recorded to be less than 0.5 m are peaty soils. Depths recorded to be greater than 0.5 m are peat, with the upper 0.30 m being acrotelmic peat and depths beyond 0.30 m considered to be catotelmic peat based on peat cores undertaken in the phase 2 peat survey.

The following sequence of tables (Table 4.1 to Table 4.6) provides a summary of the indicative peat extraction volume calculation for each infrastructure element. The relevant design assumptions are also confirmed within each table. All volumes are stated to the nearest 100m^3.

Table 4.1: Wind Turbine Foundations

Turbine ID	Mean Peat Depth (m)	Peat Excavation Volume (m^3)		Total Peat Excavation Volume (m^3)
		Acrotelmic Peat	Catotelmic Peat	
T01	0.3	0	0	0
T02	0.4	0	0	0
T03	0.6	192	192	384
T04	0.4	0	0	0
T05	0.2	0	0	0
T06	0.8	192	320	512
T07	0.5	0	0	0
T08	1.0	192	447	639
T09	1.7	192	895	1,087
T10	0.9	192	383	575
T11	1.6	192	831	1,023
T12	0.7	192	256	448
Total Peat Excavation (m^3)		**1,344**	**3,324**	**4,668**

Source: Natural Power

Table 4.2: Turbine Crane Hardstanding

Turbine ID	Mean Peat Depth (m)	Peat Excavation Volume (m^3)		Total Peat Excavation Volume (m^3)
		Acrotelmic Peat	Catotelmic Peat	
T01	0.3	0	0	0
T02	0.4	0	0	0
T03	0.8	580	960	1540
T04	0.7	580	770	1350
T05	0.4	0	0	0
T06*	0.9	580	1160	1740
T07*	0.7	580	770	1350
T08*	1.2	580	1730	2310
T09*	1.7	580	2700	3280
T10*	0.7	580	770	1350
T11*	1.5	580	2310	2890
T12*	1.0	580	1350	1930
Total Peat Extraction (m^3)		**5,220**	**12,520**	**17,740**

Source: Natural Power – Explore Floating or Peat Displacement Construction Methods to Avoid Excavation

Table 4.3: Access tracks with Floating Track Scenarios

ID	Segment Details	Track Type	Approximate Length (m)	Mean Peat Depth (m)	Peat Excavation Volume (m^3)		Total Peat Excavation Volume (m^3)
					Acrotelmic Peat	Catotelmic Peat	
1	T01 Track	Cut		No Peat	0	0	0
2	T02 Track	Cut		No Peat	0	0	0
3	T03 Track	Cut		No Peat	0	0	0
4	T07 Track	Cut	630	0.7	1,210	1,613	2,822
5	T04 Spur	Cut	260	0.7	500	666	1165
6	T06 to T05	Cut	1040	No Peat	0	0	0
7	T08 to T06	Cut	100	1.1	216	576	792
8	T10 to T08	Cut	100	0.5	180	120	300
9	T9 Spur	Cut	100	1.6	246	1066	1,312
10	T11 Spur	Cut	100	1.6	246	1,066	1,312
11	T12 to T10	Cut	100	0.8	198	330	528
12	Entrance to T12	Cut	100	1.5	240	960	1,200
			Total Peat Extraction (m^3)		**3,036**	**6,397**	**9,431**

Table 4.4: Anicllary Infrastructure

ID	Mean Peat Depth (m)	Peat Excavation Volume (m^3)		Total Peat Excavation Volume (m^3)
		Acrotelmic Peat	Catotelmic Peat	
Energy Storage Construction Compound	1.6	1,350	5,850	7,200
Control Building Hardstanding	1.6	1,000	4,320	5,320
Total Peat Extraction (m^3)		**2,361**	**10,231**	**12,592**

Source: Natural Power

Peat Extraction Volume Summary

Table 4.5: Total Peat Extraction (Indicative) Site Wide

Construction Element	Peat Excavation Volume (m^3)		Total Peat Excavation Volume (m^3)
	Acrotelmic Peat	Catotelmic Peat	
Wind Turbine Foundations	1,344	3,324	4,668
Crane Hardstands	5,220	12,520	17,740
Access Tracks	3,036	6,397	9,431
Ancillary Infrastructure	2,361	10,231	12,592
Total Peat Extraction (m^3)	**11,961**	**32,472**	**44,431**

Source: Natural Power

4.3. Re-Use Volumes of Excavated Peat

In order to estimate the volume of peat that can be re-used; Natural Power has applied experience from the construction management of wind farms across an array of upland peat sites. Figure 4.2 below provides an approximate total re-use volume. The following additional design assumptions salient to the re-use of excavated peat are highlighted below:

- The uppermost 0.5 m of excavated peat at all infrastructure locations will be accommodated in the finishing and landscaping of each infrastructure element;
- In the construction of cut access track there will be the opportunity to accommodate $2m^3$ of peat per linear metre of track
- In the construction of the floated access track there will be the opportunity to accommodate approximately $3m^3$ of peat per linear meter in the creation of low angle landscaped verges that will seek to provide visual continuity between the access track and the surrounding peatland. Figure 4.2 below provides an approximate indication as to the dimensions and form of the landscaped verges:

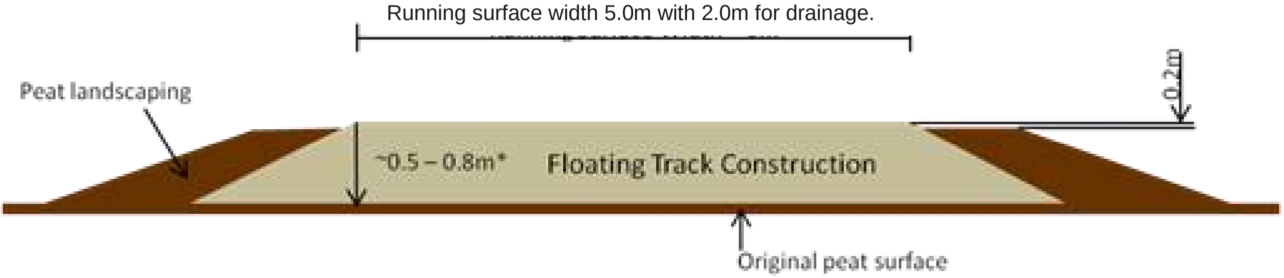


Figure 4.2: Schematic of a cross section to peat landscaped verges

- This approach is taken to provide visual continuity between the raised infrastructure and surrounding peatland, while maintaining important hydrological and drainage conditions. This assumption has been carried forward into the estimates for re-use of peat (Table 4.6);
- The finishing and landscaping of the access tracks will be extended to a region of 3.5 m either side of the running length;
- The formulation of a detailed construction method statement shall incorporate detailed construction design and sequencing for the reinstatement purposes that will allow refinement of the excavation volumes presented in this document. These plans shall draw on detailed site investigation information gathered prior to the commencement of construction; and
- Appropriate signage shall also be considered to warn of potentially soft ground hazards. The safety measures shall be maintained for as long as the hazard remains, which may be several years following construction. Typically, vegetation re-growth and natural stabilisation of the wetland areas would be anticipated within approximately two years following reinstatement. Ongoing periodic monitoring of the progress of restoration would be required to ensure fencing is maintained until the wetland is fully established.
- During the excavation and re-use of peat deposits the two layered structure of the 'acrotelm' and underlying 'catotelm' shall be preserved as far as is practicable (Figure 4.2). This approach will aid in the successful re-vegetation and prevent drying and desiccation of the peat. Where the catotelmic peat becomes separated appropriate measures shall be in place to ensure this material is stabilised prior to re-use. This will be verified by a suitably qualified geotechnical engineer.

Source: Good Practice During Wind Farm Construction

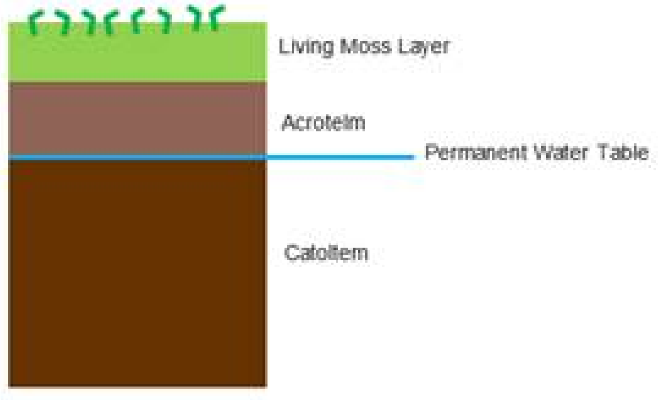


Figure 4.2: Diagram showing idealised peat structure

Re-use Volume Estimate

Table 4.6: Estimate of Peat re-use Volumes with Floating Tracks Scenario

Construction Element	Peat Extraction Volume (m^3)	Peat Re-use Volume (m^3)	Surplus (+) or Reuse Capacity (-) (m^3)
Turbines	4,668	2,240	+2,428
Crane Pads*	17,740	19,950	-2,210
Access Tracks	9,431	13,970	-4,539
Ancillary Infrastructure	12,592	11,875	+717
Total	**44,431**	**48,035**	**-3,604**

**Assumes advanced construction techniques to avoid peat excavation at deep peat locations*

Comparing the volume of re-usable peat with volume of excavated peat: there is estimated to be a capacity of approximately 3,600m^3.

The site has an area of historic peat cutting, restoring this area as a peat land utilising excavated peat from the wind farm construction could also be considered if additional capacity is required. This area is identified as artificial peat drainage features on the geomorphological map within the peat slide risk assessment and included within this report also (Figure A.3).

Further measures that can be taken to minimise bulking of the excavated peat deposit include:

- Reduction of peat handling with re-use of peat undertaken as close as possible to the excavation site;
- Maintaining the integrity of the excavated peat mass including preservation of the surface acrotelm layer as far as is practicable; and
- Prevent the drying and desiccation of excavated peat deposits through timely re-vegetation and preservation of the surface hydrology systems.

4.4. Temporary Peat Storage

Consideration for the storage of peat has been undertaken with input gathered from the Scottish Renewables Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and Minimisation of Waste.

The temporary storage of excavated peat shall seek to minimise disturbance of deposits by minimising haul distance between temporary peat storage sites and re-use areas. In general, it shall be a priority to avoid a single site dedicated temporary peat storage area. A progressive construction method which re-cycles peat through excavation and timely re-instatement in a continuous process shall be adopted for the construction of access tracks, hardstand areas and foundation elements. However temporary infrastructure elements shall require storage of peat prior to re-instatement at the end of the construction phase.

For temporary compounds, it is proposed that stripped peat and superficial deposits are temporarily stored in stockpiles / bunds adjacent and surrounding each infrastructure site. Suggested areas for the stockpile storage have been identified in the temporary storage map (Figure A.9) appended to this report. The exact areas identified for temporary storage shall only be defined following a detailed site investigation and in line with all ecological constraints.

Surrounding these areas, the peat stability, drainage and pollution prevention mitigations shall be appraised as part of the detailed construction method statement. In general areas of deeper peat (>1.0 m) shall be avoided for dedicated temporary storage areas and where possible peat storage areas will be located on <0.5 m peat. It would be a priority to ensure that a future detailed site investigation provides information on the suitability of these temporary peat storage areas including the topographic profile, groundwater regime, and geotechnical properties of deposits underlying the temporary storage sites. Furthermore, it may be necessary to undertake further peat stability calculations based on finalised placement of temporary peat storage areas.

In temporary storage areas; peat shall be stored on geo-textile matting which acts as a protective barrier to the underlying soils and vegetation. The geo-textile shall be designed to prevent ingress of groundwater and erosion and de-stabilisation of the base of the stored peat. Peat shall be stored to a maximum depth of 1m with the peat turfs stored separately from underlying peat. The peat turfs or vegetation layer shall be stored in a single layer.

A system of watering the stored peat and turfs / vegetation shall be in place to ensure that the peat remains damp and prevents drying out and desiccation. The vegetation layer and seed bank shall therefore be sustained. This is an important element in the restoration of infrastructure, providing continuity with surrounding local vegetation upon reinstatement. For the duration of the temporary storage it shall be necessary to periodically monitor the condition of the stored peat and ensure the stability is maintained. This may need to be undertaken by a suitably qualified geotechnical engineer.

4.5. Limitation of Assessment

The peat extraction and re-use volumes are intended as a preliminary indication. The total peat volumes are based on a series of assumptions for the development layout and peat depth data averaged across discrete areas of the development. Such parameters can still vary over a small scale and therefore local topographic changes in the bedrock profile may impact the total accuracy of the volume calculation. Where total volumes have been stated these have been rounded to the nearest 100 m^3 in order not to convey a false accuracy.

The accuracy of these predictions may be improved though detailed site investigation (pre-construction). It is therefore important that the Peat Management Plan remains a live document throughout pre-construction and construction phases and is encapsulated within the wider Environmental Management Plan. The peat management plan and volumetric assessments can be updated as more accurate information becomes available.

Interpolated peat depth maps (as presented in Appendix A) illustrates the peat depth across the site, thus giving an indicative assessment of the peat depths at various infrastructure locations. As will be discussed in the following sections, the excavated peat and peaty soils across the site can be used in a variety of scenarios including dressing side slopes on the roads; backfill over turbine bases, and used in landscaping of access tracks.

5. Reinstatement Methodologies

Prior to commencing the construction excavation works, consideration will be given to methods for handling and holding the excavated materials, particularly peat. Haulage distances for the excavated material will be minimised, in order to reduce the potential impact on the peat structure. Peat has the potential to lose structural integrity upon excavation particularly when double handled or moved around the site. Peat handling can also increase the bulking factor of the material which has the overall effect of increasing the volume of peat which will need to be re-used across the site. Here are presented reinstatement measures that can be adopted for the main infrastructure components associated with the development.

5.1. Access Tracks

During track excavation works, where possible the vegetated top layer of material, which holds the seedbank, will be stripped and set to the side of the worked area for re-use in the re-profiling and track verge reinstatement works. The vegetative layer will be stripped as whole turves, where tree stumps are not present, and will be set aside vegetation side up. Figure 5.1 indicates where good practice has promoted vegetation re-establishment.

Source: SNH, FLS

Figure 5.1: Effective Turf Management and subsequent re-establishment of verge

Where cut and fill tracks are required in areas of peat or remnant peat habitat, then reinstatement will involve laying subsoil peat on the cut batters and then placing peat turves and clods on top of this. Reinstatement will be completed as soon as possible following construction to minimise the risk of turf drying. Restoration will be carried out as track construction progresses (Figure 5.2).

Source: Natural Power

Figure 5.2: Example of verge reinstatement ongoing with drainage provision

In order to obtain the best results, the previously stripped soils, vegetated layers or turves will be brought back over the verges of constructed tracks within as short a time period as reasonably practicable, to give the seed bank and vegetation the best chance of an early regeneration. Where reasonably practicable, turves and topsoil will be matched to the adjacent habitat.

Where practical, if storage is required, the layers will be correctly stored in their respective soil/peat horizons, i.e. in the layers that they were stripped in, so when reinstated they can be put back in the correct order. This also provides the seedbank and vegetation the best chance of early regeneration. If temporary storage of excavated materials is required, then material will be stored safely, and the method of storage will be reasonably minimised in order to reduce areas of additional disturbance. If materials are to be stored for any length of time, then these designated areas will be agreed with the ECoW prior to the storage of any material. Consideration will also be given to periodically wetting the vegetation layers in order to prevent drying out. If this method is implemented, any runoff will be dealt with appropriately and will not be allowed to discharge into any adjacent watercourses unless treated.

Peat will only be used to re-profile or finish off the edges of the track or where construction has damaged the surface layer (Figure 5.3). In order to re-establish vegetation in these areas as quickly as possible peat turves will be utilised wherever practical.

Source: Natural power

Figure 5.3: Example of access track verge reinstatement

The soil and peat material that is utilised for the track edge reinstatement will not be spread too thinly. If the material is spread too thinly then there is a tendency for it to dry out and crack, particularly during prolonged dry periods. This subsequently means that the soil/peat material will be unstable because the root system has not had an opportunity to establish. This is very much dependent upon the time of year that the work is taking place and also the altitude. These factors affect the growing performance of the vegetated turf. Early reinstatement will be undertaken as this provides for the most beneficial results.

Care will also be taken to ensure that excessive material is not used during the re-profiling and reinstatement of the track verges. In addition, excess peat will also not be used for reinstatement of track edges where it can lead to the additional loss of habitat, by smothering the existing adjacent vegetation and preventing re-growth of the vegetation next to the tracks. The addition of excessive materials may cause instability at the track edges and increase the risk of the creation of sediment laden runoff.

The fundamental aspects of track reinstatement are summarised as follows:

- Consider haulage methods and specified storage locations in relation to areas being worked. Haulage distances to storage locations will be minimal;
- Vegetated turves and topsoil will be stripped with care and stored correctly i.e. separated in horizons and vegetation stored vegetation side up;
- For track reinstatement peat will be placed back in the correct horizon order and topsoil containing the seed bank will be on the top. If vegetated turves have been previously stripped, then these will be placed on top to maximise vegetation growth potential;
- Reinstatement of verges will be completed as soon as practical to minimise turf drying i.e. reinstatement can take place whilst track construction continues;

- Peat soil will not be spread too thinly during verge reinstatement in order to prevent cracking/drying out and excessive amounts of peat will also not be used as this can lead to unstable surfaces, effect drainage, loss of habitat via smothering of adjacent vegetation and create sediment laden runoff; and
- Natural regeneration of vegetation is the preferred option for reinstatement and restoration, however, if required, following consultation with Northern Ireland Environment Agency (NIEA), re-seeding using a native species mix may be considered.

5.2. Cable Trenches

The reinstatement and storage of any excavated materials for the cable trenches will involve replacement of previously stripped soils, vegetated layers or turves (Figure 5.4). Timing of trench reinstatement works will also consider adjacent construction activities which may disturb any reinstatement works already carried out.

Source: Nartural Power

Figure 5.4: Reinstatement of cable trench adjacent to access track – aerial survey

The amount of time between the excavation of the trench and subsequent reinstatement following cable laying will be minimised as much as practically possible. The reason for this is that the longer the stripped turves are stored for, the more they will degrade and become unsuitable for successful reinstatement. Reinstatement will take place as soon as possible, trenches which are left open for a long period of time will have a tendency, to act as conduits for surface water runoff, thus potentially leading to increased sediment loading due to erosion. This could potentially affect the sites watercourses and lead to the occurrence of a pollution event.

The type of vegetation used for reinstatement will not differ significantly from the adjacent area. The fundamental aspects of cable trench reinstatement are summarised as follows:

Cable trenches will be constructed to the relevant detailed design specifications;

- Cable trenches will be constructed adjacent to access tracks, i.e. reducing construction impacts on virgin ground;

- As a general principal, reinstated areas will be not be re-disturbed. This will be avoided where practical though not always possible due to construction sequencing;
- Stripping, storage and reinstatement of excavated materials will be as per best practice;
- Time between trench excavations and reinstatement will be planned to reduce the potential for stored turf layers to dry out and decompose; and
- Natural regeneration of vegetation is the preferred option for reinstatement and restoration.

5.3. Wind Turbine Foundations

Where practical the peat turves and topsoil will be stored around the perimeter of the foundation excavation, as shown in Figure 5.5. A plan showing where the material is to be stored will also be created prior to the works commencing. In areas where storage of the peat turves or excavated material adjacent to the works is not possible, then the material will be taken to the nearest agreed storage areas as soon as possible.

Source: Natural Power

Figure 5.5: Excavated material stockpiled around the perimeter of the foundation excavation

The turbine foundations will be backfilled with the excavated material. Not all excavated material will be suitable for backfilling or reinstatement. The previously stripped and stored soils, and vegetated layers or turves will then be spread over the disturbed area, caused by turbine foundation construction (Figure 5.5). Where turbine bases are constructed in peat, reinstatement will involve laying subsoil peat on the backfilled area and then placing the vegetated peat turves on top. Reinstatement will be carried out as soon as practically possible following completion of foundation construction to minimise the risk of turves/vegetated layers drying out.

The fundamental aspects of turbine foundation reinstatement are summarised as follows:

- Construction works will be carried out to the detailed specification of the turbine foundation design and to permit adequate temporary works. Excessive peat excavation will be minimised.
- Stripping, storage and reinstatement of excavated materials will be as per best practice;
- A detailed plan of where excavated material will be stored will be created;
- Subsoil/peat will be spread over the backfilled area during reinstatement. Peat turves will then be placed on top to encourage natural re-growth of the vegetation;
- Time between turbine foundation excavation and reinstatement will be planned to reduce the potential for stored turf layers to dry out and decompose; and
- Natural regeneration of vegetation is the preferred option for reinstatement and restoration.

5.4. Crane Hardstanding

Reinstatement of the permanent elements of crane pads will not occur:

- In the past crane pads have been reinstated using a layer of peat following construction. On many sites this layer has been stripped back within 2-3 years of operation to allow maintenance works to take place; and
- When the peat is stripped back, it mixes with the stone from the hardstanding, thus contaminating the peat layer and making it unsuitable for re-use for reinstatement.
- Due to the requirement for hardstands to remain in place, and use of crane pad areas during maintenance activities, levels of vegetation re-growth are liable to be low if crane hardstands are covered.
- The area around the crane pad and any exposed batters will be reinstated with previously stripped soils, vegetated layers and turves, using the same methods to those described for track reinstatement.

5.5. Ancillary Infrastructure

All temporary constructed areas, with exception of the construction compound, will be removed and reinstated following construction. The construction compound will be reused for battery storage and therefore the hardstand surface at the construction compound will remain in place. For all other temporary construction areas the hardstand surface will be lifted or scarified or loosened prior to re-soiling to aid with drainage and re-generation.

The reinstatement will involve reprofiling/landscaping to ensure that the reinstated area blends in with the surrounding area. Suitable materials i.e. topsoil and/or peat will then be placed over the area in appropriate horizons i.e. in the correct order. The material used for the reinstatement works (often that which was excavated for the temporary construction area), will be stored and managed adjacent to the temporary construction areas but away from watercourses and other sensitive receptors.

It is highly probable that the temporary construction areas, with exception to the site compound, will only be required for the duration of the construction period. Therefore, it is possible that where any stripped turves may not be suitable for reinstatement, vegetation may be allowed to regenerate naturally. Natural regeneration could take several years and is dependent upon the type of adjacent vegetation and the altitude of the location. Re-seeding will be considered if required. If re-seeding is required, the seed type and mix will be agreed in consultation with NIEA.

The fundamental aspects of temporary construction reinstatement are summarised as follows:

- Areas will be re-profiled/landscaped to ensure they blend in with the surrounding area;
- Topsoil/peat will then be spread over the area in its appropriate horizons;

- Material used for the reinstatement will be stored appropriately where practical adjacent to the temporary construction area;
- Stripped turves may dry out due to the length of time they are stored (compound required for duration of construction period) therefore may not be suitable for reinstatement; and
- Natural regeneration of vegetation is the preferred option for reinstatement and restoration.

6. Monitoring

The success of construction and the subsequent re-use of peat across the site can be monitored to ensure that effects on the peat land environment are appropriately understood and subsequently reduced via any remedial works that can be undertaken. The details of any required monitoring would be discussed and agreed with the Planning Authority and relevant consultees prior to commencement. Appropriate monitoring is important to:

- Provide reassurance that established in-place mitigation and reinstatement measures are effective and that the site is not having a significant adverse impact upon the local and/or wider environment;
- Indicate whether further investigation is required and, where pollution is identified or unsuccessful reinstatement, the need for additional mitigation measures to prevent, reduce or remove any impacts on the environment; and
- Understand the long-term effects of the site on the natural environment.

Due to the nature of the construction activities and the possibility that such works can increase the volume of dissolved and particulate matter from entering the natural drainage network a robust hydrological monitoring strategy will be implemented. Full details of proposed drainage are provided in the ES Volume 2 Chapter 10: Geology and water environment.

A reinstatement monitoring strategy can also be implemented, where surveys can be carried out to monitor the success of peat re-use and subsequent reinstatement. Complimentary to the hydrological monitoring highlighted above and best practise geotechnical monitoring, the success of vegetation reinstatement can provide an insight into the effects of the wind farm on the local environment. Full details of the environmental monitoring strategies will be finalised following consultation with the Planning Authority and relevant consultees.

7. References

- BS EN 1997-1:2004, EC7: Geotechnical Design, Part 1: General Rules.
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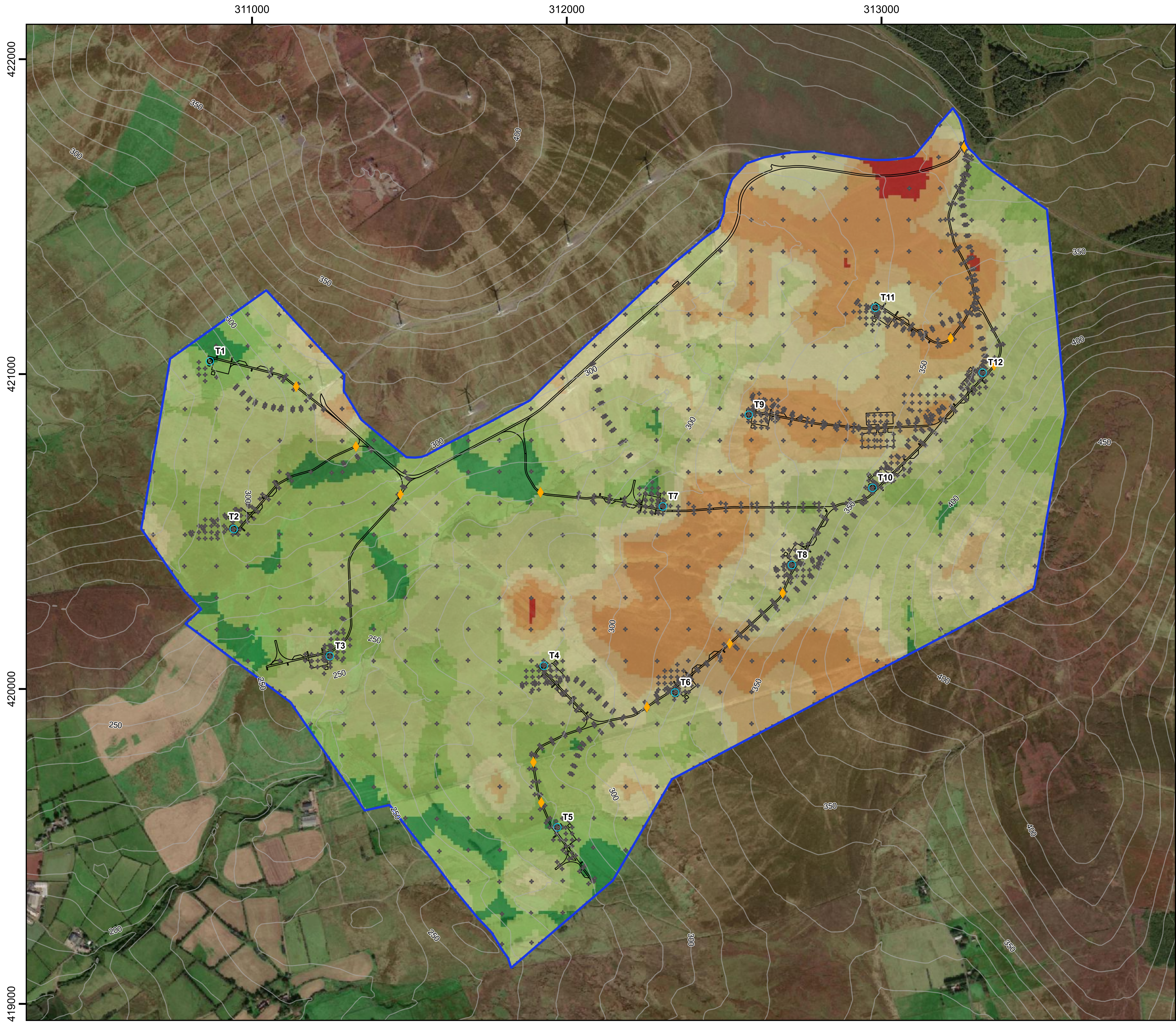
- British Geological Survey, Northern Ireland 1:50,000 Digital Data.
- Good Practice During Wind Farm Construction, A joint publication by: Scottish Renewables, Scottish Natural Heritage, Scottish Environmental Protection Agency, Forestry Commission Scotland, Historic Environment Scotland, Marine Scotland Science, AEECoW, 4th Edition, 2019.
- Developments on Peatland: Guidance on the assessment of peat volumes, re-use of excavated peat and the minimisation of waste (A joint publication by Scottish Renewables, Scottish Natural Heritage (SNH), SEPA, Forestry Commission Scotland, 2012).
- Floating Roads on Peat (Forestry Civil Engineering & SNH, 2010).

A. Appendix - Maps

- Figure A.1 Interpolated Peat Depth
- Figure A.3 Geomorphological Features
- Figure A.9 Suggested Temporary Peat Storage Locations



Project:

Carnbuck Wind Farm, Co. Antrim, Northern Ireland

Title:

Figure A.1: Interpolated Peat Depth

Key

- Site Survey Boundary
- Proposed turbine
- Peat probe
- Infrastructure footprint
- Water crossing

Peat depth (m BGL)*

- ≤ 0.25
- ≤ 0.5
- ≤ 1
- ≤ 1.5
- ≤ 2
- ≤ 3
- ≤ 4

* Peat probe data interpolated using kriging method

Scale @ A3: 1:12,000

Coordinate System: TM75 Irish Grid

0 125 250 375 500 m

N

Date: 15-04-22	Prepared by: IW	Checked by: SF
Ref: GB201993_M_005_D	Layout: 280322_12t_A	

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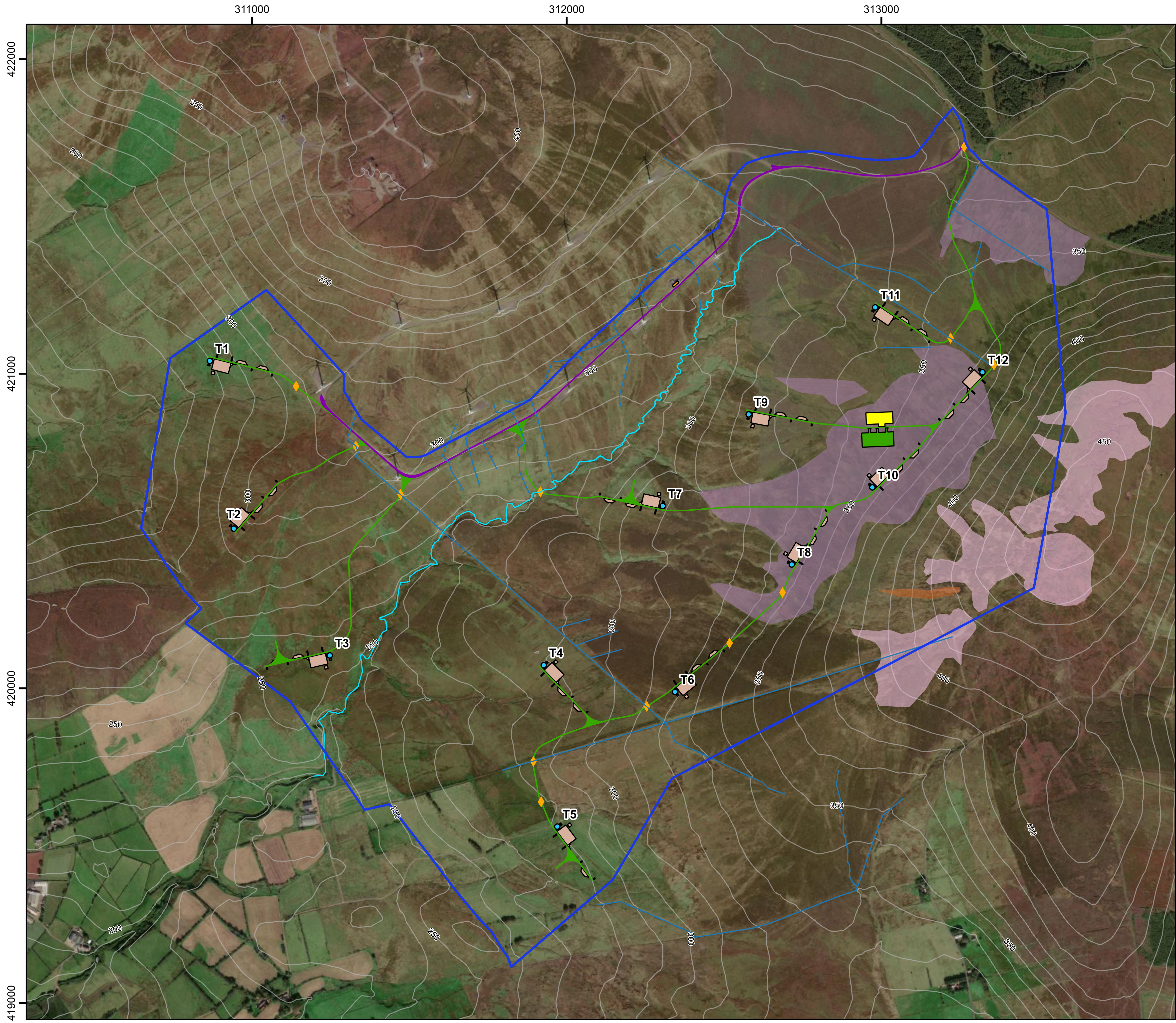

Project:

Carnbuck Wind Farm, Co. Antrim, Northern Ireland

Title:

Figure A.3: Geomorphological Features

Key

- Site Survey Boundary
- Proposed turbine
- Upgraded existing track
- Proposed track
- Proposed hardstanding
- Proposed control building and substation compound
- Proposed energy storage / construction compound
- Existing Gruig Wind Farm substation
- Water crossing

Geomorphological feature

- Peat artificial drainage area
- Peat hag
- Slide / escarpment
- Drainage ditch
- Watercourse

Scale @ A3: 1:12,000

Coordinate System: TM75 Irish Grid

0 125 250 375 500 m

N

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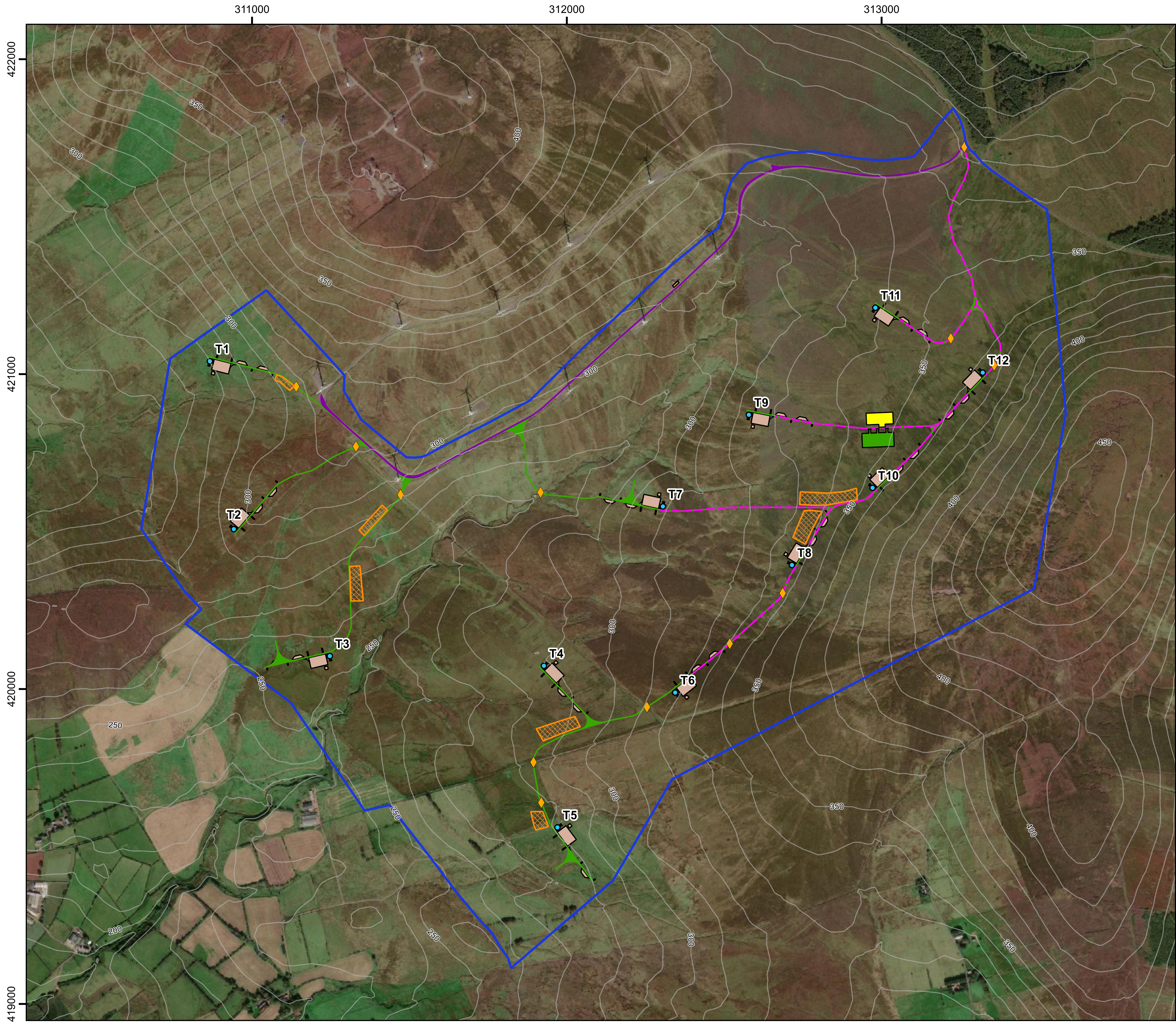

Project:

GruCarnbuck Wind Farm, Co. Antrim, Northern Ireland

Title:

Figure A.9: Temporary Peat Storage Locations

Key

- Site Survey boundary
- Proposed turbine
- Upgraded existing track
- Proposed track
- Indicative Floating Track Type
- Proposed hardstanding
- Proposed control building and substation compound
- Proposed energy storage / construction compound
- Existing Gruig Wind Farm substation
- Water crossing
- Indicative temporary peat storage

Scale @ A3: 1:12,000

Coordinate System: TM75 Irish Grid

0 125 250 375 500 m

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