Appendix 10-3: Outline Peat Management Plan (oPMP)

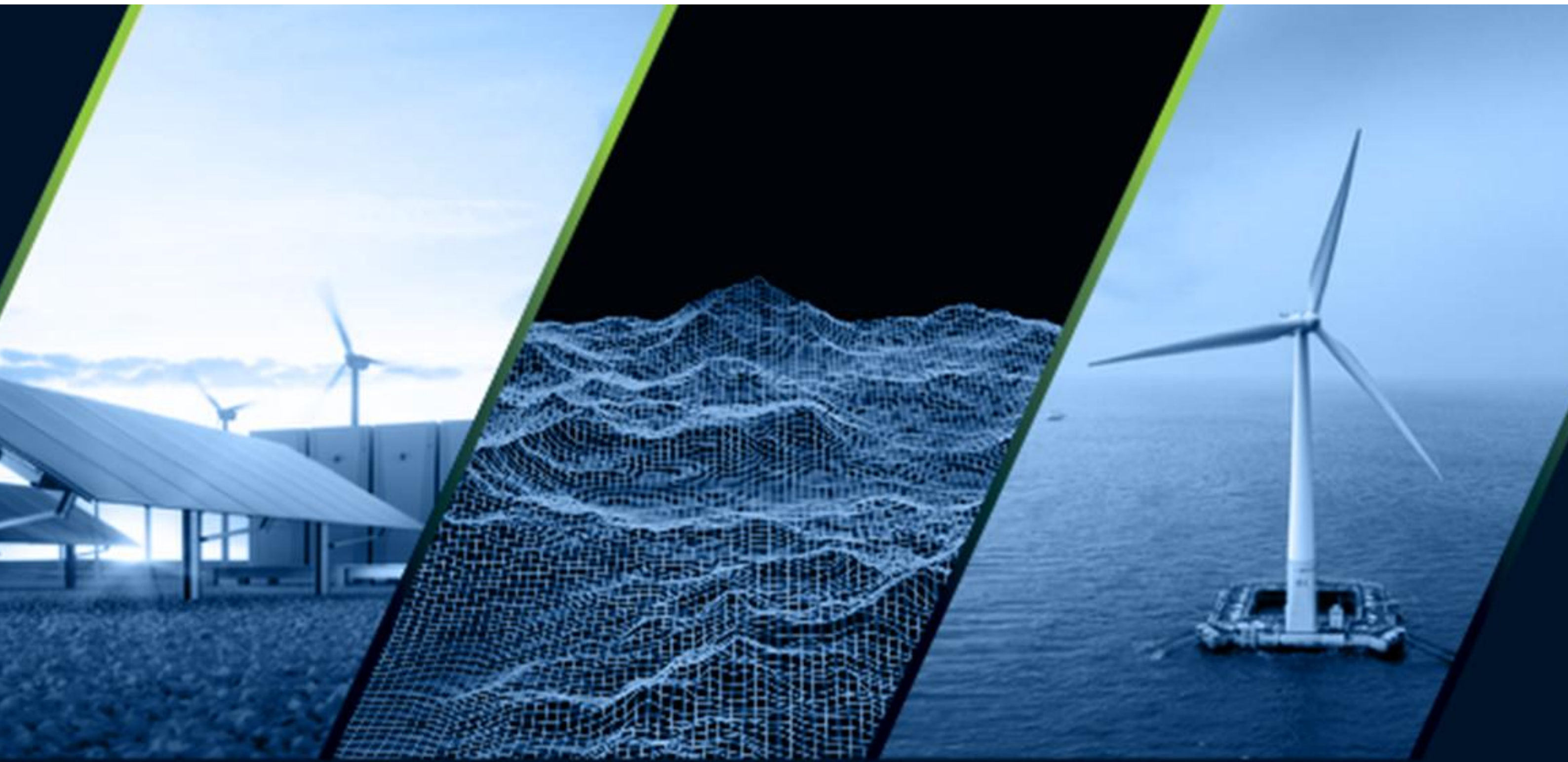
Calderdale Energy Park

PEIR Volume 3
PINS Reference: EN0110023
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 – Reg 5 (2) (a).

7 April 2026

Calderdale
energy park

The **Renewable Energy** Consultants.



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Appendix 10-3: Outline Peat Management Plan (PEIR)

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Information

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1 Introduction

1.1 Background

Calderdale Wind Farm Ltd (the 'Applicant') is seeking a Development Consent Order (DCO) for construction of Calderdale Energy Park (the 'Proposed Development').

The area for the Proposed Development (the 'PEIR Boundary') lies north of Hebden Bridge and is located to either side of the three Walshaw Dean Reservoirs. The Turbine Area, where the wind turbines will be located within the PEIR Boundary is c. 2,227 ha in area, and is centred on Ordnance Survey grid reference SD 96688 33581. The Turbine Area is located to the north of Hebden Bridge, to the northwest of Halifax and to the east of Burnley. At its maximum, the Turbine Area extends approximately 9.3 km east-west and approximately 4.9 km north-south. The Turbine Area is located wholly within the administrative boundary of Calderdale Metropolitan Borough Council ('Calderdale Council'). **Plate 1.1** shows the location of the Turbine Area as well as the Western Access Route, Eastern Access Route and Bradford West Cable Corridor.

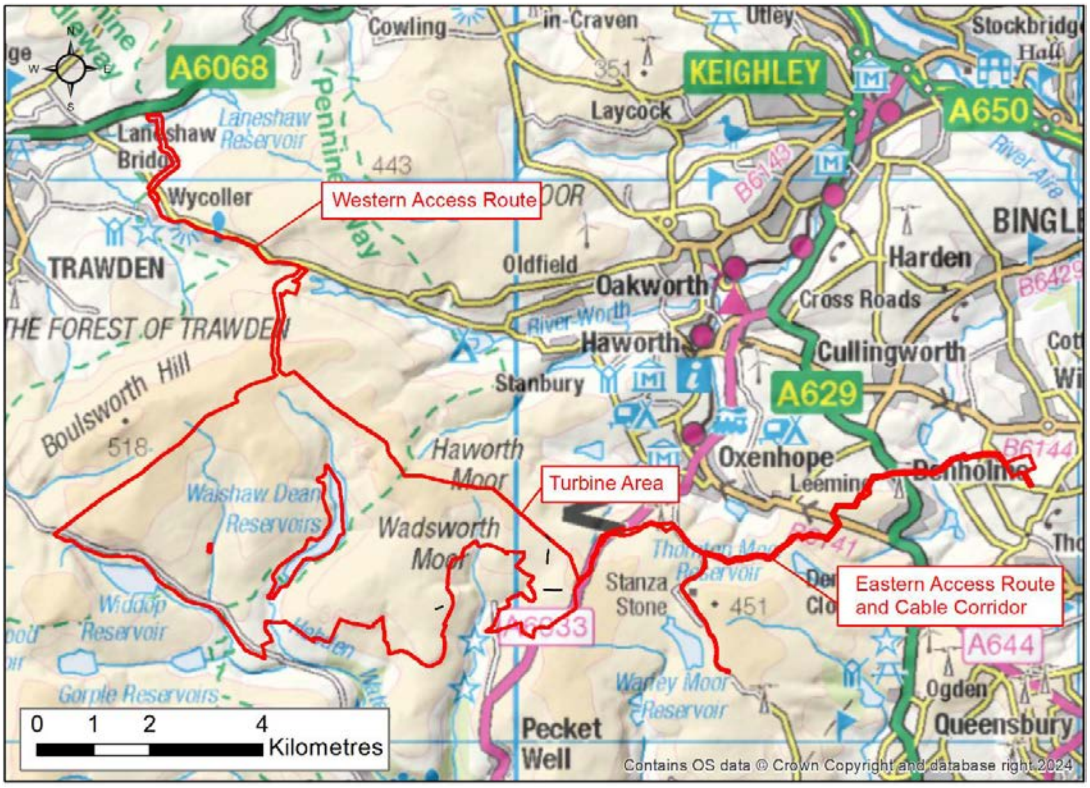

Plate 1.1 Location of the Proposed Development

The Bradford West Cable Corridor linking the Turbine Area to the Bradford West Substation and the Access Routes have yet to be surveyed and therefore these components of the Proposed Development are not considered within this technical appendix.

The Proposed Development comprises:

- Up to 34 turbines with associated permanent and temporary hardstandings and turning heads;

- An onsite substation and associated compound;
- Internal site access tracks of cut and fill and floating construction, the former including upgrades to existing tracks;
- Borrow pits for supply of aggregate for construction;
- Temporary construction compounds; and
- Other associated infrastructure, including drainage.

This Outline Peat Management Plan (oPMP) has been prepared under the Nationally Significant Infrastructure Projects (NSIP) regime in response to a Scoping Opinion received from the Planning Inspectorate (PINS) dated 10/10/2025. This oPMP supports the Preliminary Environmental Information Report (PEIR), which has been prepared in accordance with the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 and national guidance. The content of the PEIR remains preliminary and subject to change as further environmental work and design development are completed prior to submission of the Environmental Statement (ES).

1.2 Definitions

In the context of this report, peat is defined as a soil comprised of ≥20% organic matter of a depth of ≥30 cm where over bedrock or weathered rock or ≥40 cm within the upper 80 cm (i.e. not over bedrock / weathered rock) excluding fresh litter and living moss (Avery, 1980).

The relevance of the use of these depth thresholds is to focus the assessment on deeper peats with a higher likelihood of a functional acrotelm / catotelm hydrological system, associated bog vegetation capable of peat forming and proportionately greater carbon storage. While shallow peaty soils less than these thresholds may be functionally linked components of the landscape, they are less likely to be characterised by these attributes.

Peat, as a soil, is defined separately to peatlands, where the latter are defined are described as wetland habitats formed in peat, the principal types being blanket bogs, raised bogs and fens. Peatland ecosystems may currently support a vegetation that is peat-forming, may not, or may lack vegetation entirely (Ramsar, 1971).

1.3 Scope of Work

The scope of the oPMP is as follows:

- Summarise the design principles adopted for design of the Proposed Development with respect to peat, including the approach to peat characterisation and the identification of opportunities taken to minimise impacts on peat and peatlands.
- Calculate the potential volumes of peat that may be excavated in association with construction, both acrotelmic and catotelmic peat.
- Identify and justify reuse of acrotelmic and catotelmic peat where it cannot be reinstated at source.
- Identify good practice measures to ensure excavated peat is stored safely and with minimal loss of function prior to its reinstatement.

The oPMP follows the advice issued in the Scoping Opinion.

1.4 Report Structure

This report is structured as follows:

- Section 2 provides an outline of relevant guidance relating to the excavation, storage and reuse of peat.
- Section 3 provides an overview of the Proposed Development and desk study review of site information.
- Section 4 describes the approach to and results of peat excavation calculations.
- Section 5 describes peat reuse both in reinstatement and in support of peatland restoration.
- Section 6 provides general good practice measures and measures specific to the conditions identified.

Where relevant information is available elsewhere in the PEIR, this is referenced in the text rather than repeated in this report.

2 Context to Peat Management

2.1 Peat as a Carbon Store

Priority peatland habitats comprise blanket bog, lowland raised bog, lowland fens, and part of the upland flushes, fens and swamps, as listed in the UK Biodiversity Action Plan (UK BAP). Blanket bog is the most widespread of these habitat types in England, and therefore it is blanket bog that is usually of relevance for proposed developments / wind farms in upland areas.

Blanket bogs in the UK started forming in the early Holocene, with most UK bogs initiating prior to 6,000 years ago under cooler and wetter conditions than at present. Where bogs remain waterlogged and peat forming plant species persist, blanket bog is still considered to be actively forming and accumulating organic matter and therefore can be considered a carbon sink. A bog that is not losing carbon/peat but is no longer accumulating organic matter can be considered a carbon store, and a degrading bog can be considered a carbon source (Mills *et al*, 2021).

A peatland may change state between sink, store and source through natural processes or as a result of human activity. The purpose of a peat management plan is to avoid impacts on the peat carbon stores at wind farm sites by avoiding peat, where possible, or by minimising impacts where peat cannot be avoided. Where there are opportunities to improve peat condition, e.g. through restoration, and in so doing, help convert carbon sources into stores or sinks, this may also be facilitated by a peat management plan (usually in conjunction with a habitat management plan, or equivalent).

2.2 Good Practice Guidance

A number of guidance documents have been issued to assist applicants in responsibly planning, installing and operating infrastructure on peat and in peatland settings, most of this originating in Scotland where the majority of larger onshore wind applications have been submitted over the last two to three decades. This oPMP has been informed by this collective good practice, which includes the following documents:

- Good Practice during Wind Farm Construction, Version 4 (Scottish Renewables, Scottish Natural Heritage, Scottish Environmental Protection Agency, Forestry Commission Scotland, 2019).
- Developments on Peat and Off-Site Uses of Waste Peat, WST-G-052 (SEPA, 2017).
- Peatland Survey. Guidance on Developments on Peatland (Scottish Government, Scottish Natural Heritage and SEPA, 2017a).
- Peat Landslide Hazard and Risk Assessments, Best Practice Guide for Proposed Electricity Generation Developments (Second Edition) (Scottish Government, 2017).
- England Peat Map (DEFRA, 2025).
- Constructed Tracks in the Scottish Uplands, 2nd Edition (Scottish Natural Heritage, 2015b).

- Developments on Peatland: Guidance on the assessment of peat volumes, reuse of excavated peat and the minimisation of waste (Scottish Renewables and SEPA, 2012).
- Floating Roads on Peat - A Report into Good Practice in Design, Construction and Use of Floating Roads on Peat with particular reference to Wind Farm Developments in Scotland (Scottish Natural Heritage and Forestry Commission Scotland, 2010).
- Effectiveness of construction mitigation measures to avoid or minimise impact to groundwater dependent wetlands and to peat hydrology (CREW, 2019).

In general terms, the guidance considers appropriate activities to be undertaken at the planning, post-consent / pre-construction and construction stages. The overarching principles are generally the same across the different guidance documents and are set out below.

During planning (e.g. preparation of application documents, including a PEIR):

i. Determine at a sufficient level of detail the distribution of peat within a site in order to assess the likely level of impact of proposed works.

ii. Calculate the volumes of peat likely to be excavated during construction.

iii. Demonstrate how excavated peat will be managed (ii and iii together comprising an assessment of the "peat mass balance").

These activities are normally considered within an oPMP, produced at the appropriate planning stages.

Following consent, during the pre-construction period:

i. A refined peat mass balance should be calculated through further site investigation works (including intrusive works such as detailed probing across final infrastructure footprints and/or trial pits to verify the nature of probed materials) – this should be presented in a post-consent PMP, superseding the oPMP.

ii. Further detailed topographic survey and design level excavation, storage and reuse plans should be drafted to enable contractors to bid for and implement the works.

iii. Key good practice measures should be identified within the PMP that integrate with other related plans or control documents for construction, including, where applicable, the Construction Environmental Management Plans, Decommissioning Environmental Management Plans, Site Waste Management Plans, Habitat Management Plan (where relevant) and Geotechnical Risk Registers (where relevant).

During the construction stage:

i. Optimise infrastructure locations relative to final pre-construction information gathered onsite.

ii. Monitor, adjust and implement the PMP to accommodate deviations in expected peat volumes and adapt reuse measures to actual site volumes.

iii. Set-up monitoring programmes to identify the new post-construction baseline and provide a basis for monitoring the success of the PMP and identify appropriate mitigation where necessary.

Through the different stages of the project, the strategy should be to prevent disturbance to and losses of peat through appropriate reuse, wherever possible.

2.3 Approach at the Proposed Development

The strategy for peat management for the Proposed Development follows good practice guidance for developments on peat and uses of waste peat in employing the mitigation hierarchy with respect to peat and peatlands. The hierarchy is as follows:

- **Prevent** the creation of waste peat by minimising overlap of infrastructure with peat, where it is possible to do so, and given other environmental and design constraints that may influence turbine locations and associated infrastructure (such as internal site access tracks).
- **Reuse** peat in construction, reinstatement or in restoration (restoring off-site will require environmental authorisation).
- **Recycle** as a soil substitute or for use in other works (where on-site or off-site use in restoration is not possible).

Disposal of peat (i.e. export from the site as waste) is not considered an acceptable outcome for materials generated during construction.

For the Proposed Development, a combination of prevention, reuse and restoration has formed the peat management strategy. Outline details of this strategy are provided below, and full details of excavation, reuse and restoration proposals are provided in Sections 4 and 5.

2.3.1 Prevent

Prevention involves minimising the amount of peat excavated during construction by informed layout planning. The extent to which this is possible is not just a function of the amount of peat on the Turbine Area but also of the presence of other constraints (e.g. landscape visual impacts, hydrology, terrestrial ecology) and the practical requirements of wind farm construction (e.g. minimum turbine spacings, acceptable gradients for tracks / hardstandings).

Much of the Turbine Area is characterised by cover of peat and opportunities to avoid it altogether are very limited without substantially compromising the scale of the Proposed Development.

Phase 1 peat depth data collected on a 100 m grid (i.e. one probe per hectare) were used to inform the initial scoping design. Subsequently, following stakeholder feedback, significant efforts were made to redesign the proposed layout using peat as a key constraint, including:

- Initial plans to located turbines high on Widdop Moor were substantially scaled back following identification of higher quality blanket bog habitat in this area, with five turbines removed and the remaining three turbines shifted downslope into less sensitive areas.
- Three turbines originally planned between Wadsworth Moor in the centre of the Turbine Area and Middle Moor in the north in the Turbine Area were scaled back to one turbine only.

- Interim Phase 2 probing data (on a more detailed grid than at Phase 1) were used to adjust turbine placement into the shallowest areas possible taking into account other constraints (including habitat, watercourse buffers and turbine ellipses defining the limits of turbulent wake effects).
- Access tracks were designed to minimise loops, avoid deeper peat, or adopt routes enabling floating (requiring gentler gradients and counter-intuitively deeper peat).

Commentary on turbine positions and peat depths is provided in more detail in Section 3 of this report. It is anticipated that post-PEIR, further layout refinements will be undertaken to reduce overlap with deeper peat, reduce excavation volumes and minimise impacts. The final design will be presented in the ES.

2.3.2 Reuse

Where peat excavation cannot be avoided, surplus peat must be reused in a way that minimises loss of ecosystem services. Broadly speaking, these ecosystem services are carbon retention, biodiversity and water regulation. If peat retains its carbon, continues to support the hydrological functions it provided prior to excavation and is able to maintain the vegetation that was present prior to displacement, then there can be considered to be no net loss of peat. Both the displaced peat and that connected to it (e.g. surrounding an excavated area) must maintain these functions.

At the Proposed Development, the reuse strategy for peat comprises two main elements:

1. Reuse in areas of temporary infrastructure to reinstate these disturbed footprints.
2. Reuse for restoration of peatland areas damaged or degraded by historical land management and / or natural erosive processes (such as gullying).

Reinstatement approaches are derived from the good practice guidance detailed in Section 2.2 and from wider good practice approaches developed as part of wind farm construction over the last few years during which appreciation of peat as a natural resource has substantially increased. Reuse and restoration options anticipated are considered in detail in Section 5 of this report.

2.3.3 Disposal

Disposal is generally regarded as loss of peat from a site, i.e. export outside a site boundary, particularly if it no longer retains its core carbon, hydrological and biodiversity functions.

Based on the preliminary calculations in this report, no disposal is anticipated as part of the Proposed Development if the reuse measures detailed in Section 5 are deemed suitable during consultation and will be subject to further design work which will be presented in the oPMP submitted with the ES.

3 Baseline Conditions

3.1 Turbine Area Overview

The Proposed Development is located on rolling upland hills centred on the three Walshaw Dean reservoirs north of Hebden Bridge. The Turbine Area comprises a series of north to south ridges with broad and gently sloping tops on which the deepest peat deposits tend to be located. The reservoirs have been constructed within the valley floors between Round Hill Grey Fosse Clough Moss and Wadsworth Moor and Middle Moor to the east. The western extent of the Turbine Area falls from Widdop Moor towards Greave Clough, while the eastern side of the Turbine Area falls towards Mare Greave Clough. West of the reservoirs, Heather Hill (463 m AOD) is separated from Round Hill (c. 435 m AOD) by Grey Fosse Clough Moss. All catchments in the Turbine Area drain to the south into either Graining Water and then Hebden Water or Crimsworth Dean Beck (and then Hebden Water).

Maximum elevations are typically c. 450 m AOD across the north of the Turbine Area, falling to c. 300 m AOD in the lower valley slopes (**Figure 10.3.1**). Notable summits are Grey Stone Hill (462 m AOD) in the west, Warcock or Peacock Hill (480 m AOD) just outside the Turbine Area and to the west, Crow Hill (458 m AOD) just outside and to the north, and along the northeast boundary Oxenhope Stoop Hill (445 m AOD), Round Hill (455 m AOD), Stairs Hill (429 m AOD) and Sun Hill (422 m AOD).

Plates 3.1 and **3.2** shows 3D perspective views of the Turbine Area with key geographical features highlighted.

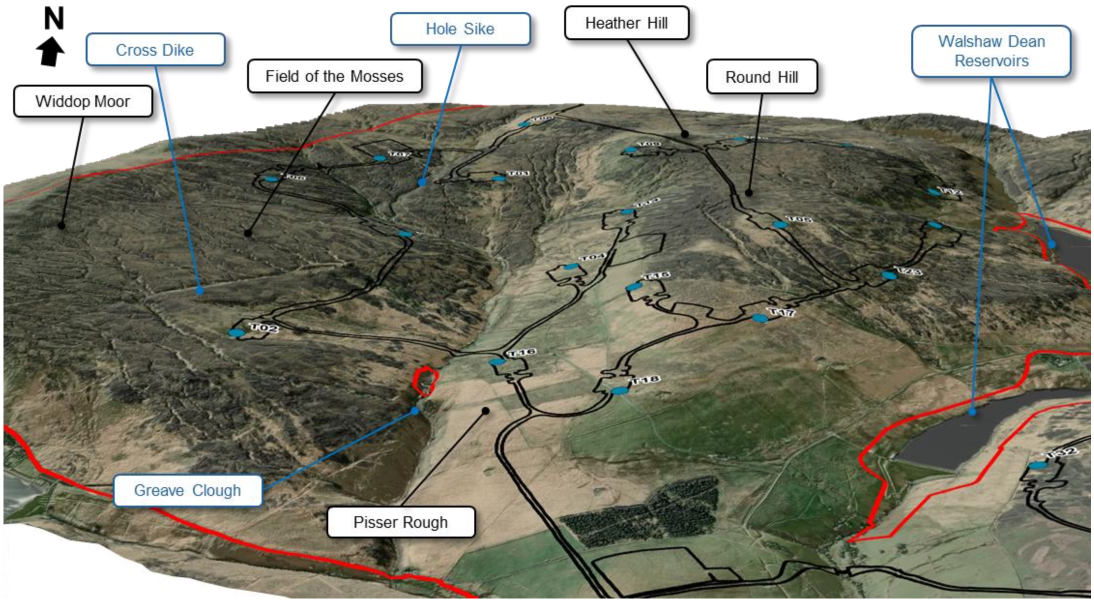

Plate 3.1 3D perspective view of west and centre of the Turbine Area

Slope angles are generally gentle (<2.5°) on the ridge tops, increasing to moderate (up to 7.5°) on the midslopes before steepening sharply on the lower valley sides close to the main watercourses (**Figure 10.3.2**). Slope angles have implications for the suitability of floating track on the midslopes.

These topographic characteristics or typical of the Pennine uplands in northern England and support development of a range of geomorphological features described in Section 3.3.

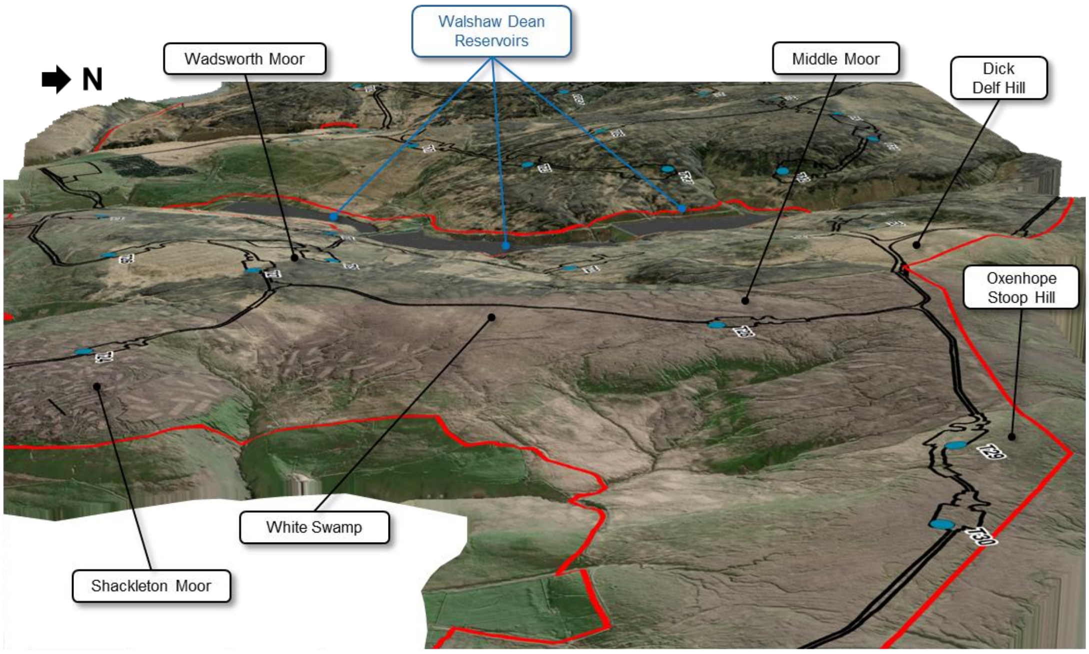

Plate 3.2 3D perspective view of centre and east of the Turbine Area

3.2 Peat Depth

Peat depth data have been collected across the Turbine Area and section of the Western Access Route (the 'Peat Survey Area') in order to support iterative layout design and provide a basis for assessing potential impacts on peat soils.

- An initial Phase 1 survey was undertaken by TNEI in April 2023. The probing was conducted on a 100 m grid and consisted of a total of 1,854 probe locations. Although the initial Phase 1 survey covered much of the Turbine Area, some areas were excluded, including areas of steeper slopes around the main reservoirs and cloughs (steep valley sides).
- In October and November 2025, detailed Phase 2 probing was undertaken by Fluid Environmental Consulting along tracks at 50 m intervals with 10 m offsets and on a 10 m grid within infrastructure footprints, totalling 6,409 locations.

The combined dataset provides a basis for refining the infrastructure design, however, subsequent to design freeze, a final dataset will be obtained on which impacts will be assessed for the ES.

The peat depth survey report (**Appendix 10-2**) summarises the approach to and results of peat depth surveys across the Turbine Area. A peat depth model has been interpolated from the peat depth data within the ArcMap GIS environment using a natural neighbour approach, as is standard good practice for characterisation of peatlands in UK wind farms. The natural neighbour approach was selected because it preserves recorded depths at each probe location, unlike some other approaches (e.g. kriging), is computationally simple, and minimises 'bullseye' effects. The approach was selected after comparison of outputs with three other methods (inverse distance weighted, kriging and TIN).

Figure 10-4.3 shows the interpolated peat depth model. Pink and purple hues deepening to blue and magenta indicate peat areas, yellow tones indicate organic (or other) soils. Probing locations are also as black points and the proposed infrastructure locations are shown as an overall wireline of their maximum extent (including earthworks) in order that the data supporting the interpolation is visible).

A summary of peat distribution is provided below:

- Peat is extensive across the Peat Survey Area from relatively low on the valley sides up onto the summits.
- The deepest peat deposits are found on Widdop Moor in the west (here exceeding 3.0 m), around the catchment headwaters in the north to the south and southwest of Crow Hill (exceeding 4.0 m) and on the ridge top between White Hill, White Swamp and Flaight Hill (again exceeding 4.0 m). Peat is regularly in excess of 1.0 m deep over large areas of the Peat Survey Area, particularly in the west and centre, less so in the east.
- In places, there are localised pockets of shallower peat (<1.0 m), but areas of soil (non-peat, i.e. <0.3 m) are relatively few and far between, mostly being located on steeper slopes close to valley axes or in the south of the Peat Survey Area where slopes steepen and / or land has been improved.

The peat depth model can be used to estimate the total volume of peat present within the full 23.5 km^2 extent of the Peat Survey Area, as shown in **Plate 1.1**. Based on the model and supporting probing, there are c. 22,250,000 m^3 of peat present in this area. This is likely an overestimate as the model assumes a continuous peat surface generated from the probing data, and linear features (such as gullies) may contain less peat than the model indicates.

In relation to the proposed infrastructure and peat:

- Inspection of turbine locations indicates that the majority have been placed in localised areas of shallower peat set within much deeper prevailing peat deposits – it should be noted that turbine ellipses (minimum separation distances to avoid turbulent wake effects) limit the proximity of one turbine to another, and apparently simple moves to reduce peat depths may not actually be achievable.
- Tracks have been aligned to exploit existing tracks where present, be routed across area of shallower peat (if possible) and specified to be of floating construction where gradients allow (<5%, or c. 3°). There is also an upper limit to gradients on tracks to ensure cranes and other vehicles are able to ascend and descend safely.
- All of the deepest peat areas on the Turbine Area have been avoided, other than along the northeastern boundary where floating track (a non-excavation technique) is proposed to the south of Crow Hill. A lower track alignment parallel and to the south of this alignment was not selected due to cross-fall gradients would then require cut and fill construction (with greater impact) and due to the presence of several large gullies below Red Mires Flat (which would have required numerous watercourse crossings).
- The substation has been sited outside the peat area since this is relatively location agnostic.

Section 3.3 describes peatland geomorphological features relevant to both the condition of the peat at the Peat Survey Area and to potential restoration opportunities.

3.3 Peat Geomorphology

A detailed account of peat geomorphology is provided within the PLHRA (**Appendix 10-4**) based on geomorphological mapping of the Turbine Area from satellite imagery and subsequent field walkover and verification. The geomorphology as relevant to peat excavation and reuse can be summarised as follows:

- Extensive linear gully systems (characteristic of moderate slopes) are present across the Turbine Area, in particular on Widdop Moor / Field of the Mosses in the west and around catchment heads in the north of the Turbine Area (e.g. **Plate 3.3a**).
- Many of these gullies are partly recovered, with vegetated gully floors, however many also have bare sides indicating ongoing erosion and oxidative carbon loss (**Plate 3.3b**).
- While areas of bare peat ('peat pans') are generally absent, these being typical of blanket peat deposits in the latter stages of degradation by erosion, in a number of areas, particularly in the west, cotton grass and other vegetation is thin and patchy revealing bare peat at the surface (**Plate 3.3c**). This means the peat is susceptible to future degradation (i.e. weathering and erosion, trampling, etc). Sphagnum moss, perhaps the most important component of actively accumulating peat is often absent, although cotton grass (the roots of which act to hold the peat surface together) is relatively widespread in the west of the Turbine Area – less so where purple-moor grass has taken hold.
- Outside the Turbine Area to the north, the Crow Hill bog burst (a much reported peat landslide, first documented by the Brontës) is located to the west of the Western Access Route (**Plate 3.3d**). This area has yet to be assessed but will be post-PEIR. These features do not typically 'reactivate' (start moving again) but the presence of past landslides can be an indicator that a site or area is susceptible to this form of instability (see **Appendix 10-4** for further details).

Plate 3.3 a) Gullying with vegetated floors and eroding sidewalls, b) bare peat within and on the sides of a gully, c) patchy vegetation and bare peat in open planar peatland, d) the Crow Hill bog burst with crescentic landslide blocks

These geomorphological features indicate that the Turbine Area is not in pristine condition, and shows symptoms of a range of both natural and human-made pressures on its peatlands. They also provide opportunities, e.g. gullies located close to infrastructure (or crossed by tracks) may be 'repairable' using translocated peat excavated from infrastructure locations. For PEIR, opportunities for this form of peatland repair have not been quantified (as volumes are sensitive to the final placement of infrastructure), but it is anticipated that this will be investigation further following design freeze and reported in the ES.

3.4 Land Use

Unlike peatlands over much of Scotland, blanket bogs in England and Wales exist in close proximity to human settlement. As a result, they often exhibit characteristics associated with both direct land management and with indirect impacts (notably in Northern England, air pollution associated with the industrial revolution). These characteristics inform the quality and condition of the peatlands and sometimes provide opportunities for restoration.

The Turbine Area is characterised by moorlands, pastures, and gritstone settlements, and includes a network of drains and ditches.

The habitat is mainly rotationally burned upland heath, managed for and used as a grouse moor, with areas of rough grazing (predominantly for sheep). The Turbine Area is also used for other recreational activities, and the vast majority of the Turbine Area is classified as Open Access Land under the Countryside Rights of Way Act 2000.

3.4.1 Drainage

The Turbine Area (and the Peat Survey Area) has been extensively modified by man-made moor drains (sometimes referred to as 'grips') (**Plate 3.4a**). Drains are cut in an attempt to improve the land surface by lowering water tables and allowing water to shed more quickly from areas of lower gradient. Sometimes this might be to encourage drier heath species (such as heather) to support game, and sometimes to prepare land for grazing stock. Over 185 km of drains have been mapped at the Turbine Area (and wider Peat Survey Area) (**Figure 10-3.4**).

Drainage is now understood to have been a harmful activity and is the focus of considerable effort across the UK in peatland restoration e.g. Peatland ACTION in Scotland, the National Peatland Action Programme in Wales and in England the Nature for Climate Peatland Grant Scheme. Organisations in the north of England have played a key part in the development of restoration techniques, including Moors For The Future, the Yorkshire Peat Partnership, the Lancashire Peat Partnership and Pennine PeatLIFE.

Because of this, many of the drains at the Turbine Area have already been restored under the Walshaw Moor Estate Catchment Restoration Plan (WMECRP) during at least two phases of drain blocking, one in 2014, and a second in 2017 (Walshaw Moor Estate & Natural England, 2017). Drains have been blocked using peat dams (**Plate 3.4b**) primarily and drains (blocked and unblocked) are shown on **Figure 10.3.4**. As a result, drains do not form part of the restoration proposals alongside the Proposed Development (unless isolated drains are not already blocked).

Plate 3.4 a) a moor drain with periodic peat dams, b) ponded water in a moor drain with little discernible effect on wider vegetation, c) an area of peat cuttings with bare cutting margins visible in the middle distance and drier vegetation on the baulks (raised area) in the foreground

In addition to traditional moor drains, larger linear drainage features that appear to be man-made are present in various locations across the Turbine Area. Many of these 'dikes' are named features and include:

- Cross Dike – a largely contour-aligned ditch in the midslopes below Widdop Moor.
- Greave Dike – a similar feature to Cross Dike situated to its southwest on Widdop Moor.
- An-unnamed dike falling from Dick Delf Hill towards White Swamp.
- Several smaller dikes that are closer in form to gullies and typically fall downslope rather than slightly down-contour.

The origin of these features is not clear, though they are generally present on the earliest Ordnance Survey maps of the Turbine Area and are known to be concentrated in Yorkshire and a small number of other regions of the UK. They are most likely to be 'head-dykes', used to limit movement of grazing stock to the upper slopes while crops grew in the lower enclosed fields. Head-dykes were in relatively common use by the late 1500s (Simmons, 2003).

Regardless of their origin, it is noted that many of the larger linear gullies on Widdop Moor and elsewhere appear to have headcut upslope from these features and therefore that the dikes may be in part responsible for some of the larger gullies visible on the Turbine Area (**Plate 3.5a and b**).

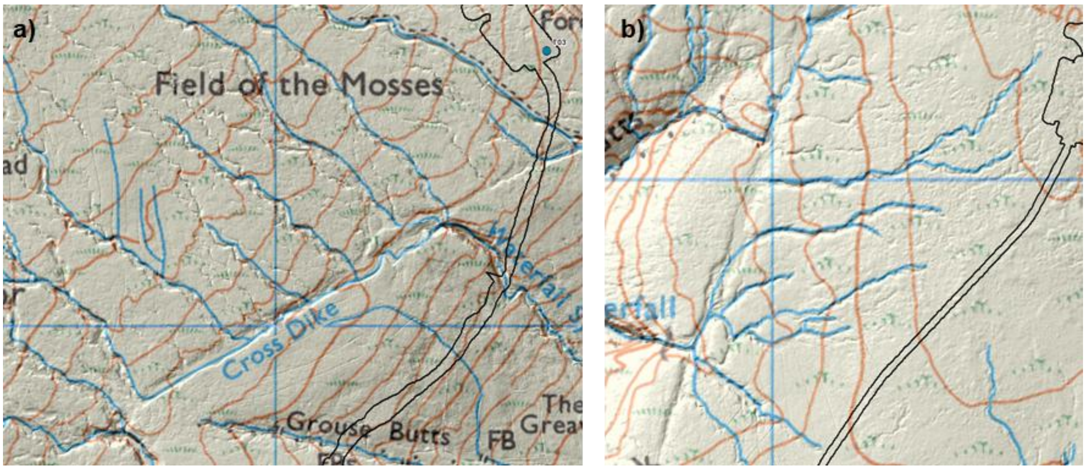

Plate 3.5 a) Cross Dike running oblique to the prevailing slope with a series of headcutting gullies extending upslope to the west (image shows LIDAR underlying OS mapping), b) similar features centred on an un-named dike below Delf Dick Hill

3.4.2 Peat Cutting

Peat is typically cut for use as fuel or for horticultural uses. LiDAR indicates numerous areas of cuttings in the south and east of the Turbine Area, particularly east of Shackleton Moor and along the eastern ridge between Dick Delf Hill and Lower Cock Hill (**Plate 3.4c**).

Cuttings leave exposed faces (similar to gully sidewalls) which are likely to be actively losing carbon, while localised drawdown of water tables in surrounding peat areas that have not been cut may also affect vegetation cover and preclude active peat formation and carbon sequestration.

Restoration of cuttings is often proposed for Scottish wind farms and involves reinstating peat into cutting footprints using peat excavated from infrastructure locations. At PEIR, this forms part of the reuse proposals for peat arisings from the construction of the Proposed Development, further detail being provided in Section 5 of this report.

3.4.3 Burning and Mowing

Satellite imagery indicates that substantial parts of the Turbine Area have been subject to either burning and / or mowing (this term is used in this report to distinguish it from peat ‘cutting’ above). While surface patterning is superficially the same, there are subtle differences, these being increasingly difficult to separate once there are multiple phases of application of these techniques in any one area. Both processes have the effect of stripping back vegetation to close to ground level, though burning may also lead to surface cracking, desiccation and damage to the uppermost peat layers. Burning is widely used on estates used for game shooting but is also a management technique for addressing heather beetle, the impacts of which have been recorded on the Turbine Area.

Management to address impacts from these forms of land management usually involves cessation of activity and is not considered in peatland restoration metrics. Nevertheless, their application does impact peatland condition (see below).

3.4.4 Grazing

Preferential grazing of peatland vegetation by stock as well as poaching (trampling) both have the potential to impact peatland condition, particularly where stocking densities are now well controlled. A shift in the balance of vegetation cover from *sphagnum* mosses and heather towards grasses and sedges often indicates excessive grazing pressure. However, in common with burning and mowing, grazing pressures are typically addressed by reducing stocking densities and these measures are complementary to, rather than the focus of, restoration activities.

3.4.5 Quarrying

Although not widespread across the Turbine Area, several quarries have been mapped within peatland areas (see **Appendix 10-4**, **Figure 10.4.6**). Peat has typically been removed to enable access to underlying mineral substrate and rock. Some of these quarries and pits may be suitable for restoration using peat excavated from nearby infrastructure.

Quarrying impacts are generally highly localised for this Turbine Area (as none of the quarries are particularly extensive) and therefore quarrying is not likely to be considered as a substantive control on peatland condition.

3.4.6 Air pollution

Past and present industrial activity in major urban centres in the north of England has resulted in gradual shifts towards dry heathland vegetation in many bogs in the wider area, with reduction in sphagnum species in the South Pennines often attributed to sulphur and other pollutants such as ammonium, nitrate and heavy metals affecting vegetation composition. In particular, atmospheric nitrogen deposition may lead to an increase in *molinia* (purple-moor grass), which dominates in various parts of the Turbine Area (**Plates 3.6a and b**).

The effects of past and present air pollution may act in concert with grazing, burning and drainage to shift vegetation from that which is generally regarded as actively peat forming (*sphagnum* and cotton grass) to less valuable species, slowing or halting active carbon sequestration and leaving a peat deposit as a store, rather than active sink. Where erosion takes hold, a peat deposit may become an active source of carbon.

While peatland restoration techniques cannot address the causes of air pollution, measures can be taken to mitigate its symptoms, including re-wetting the surface (to favour bog mosses and counteract drainage) and mechanical removal of undesirable grasses and sedges (principally *molinia*), again to the benefit of bog mosses. It is likely that these measures will be included in the final habitat management plans for the Proposed Development in order to complement the drain blocking undertaken as part of the WMECRP.

3.4.7 Tracks and footpaths

The Turbine Area is crossed by the Pennine Way and a number of other public footpaths. The Pennine Way enters the Turbine Area in the south and follows the eastern side of the Walshaw Dean reservoirs before ascending via Withens Height End towards Dick Delf Hill. It then falls towards Haworth after the catchment divide. The Calder/Aire Link rises over the ridge summit between Stairs Hill and Sun Hill in the east of the Turbine Area.

Estate tracks are also present in the lower slopes and cut across the Turbine Area at higher elevations, notable over Shackleton Moor via Round Hill. These tracks often follow the reservoirs or link lines of grouse butts to the secondary roads in the south of the Turbine Area.

3.4.8 Reservoirs

The three Walshaw Dean reservoirs lie in the valley floor in the centre of the Turbine Area (**Plate 3.6c**), are operated by Yorkshire Water and provide drinking water to Halifax.

Plate 3.6 a) molinia (purple moor-grass) in the west of the Turbine Area, b) molinia in the centre of the Turbine Area, c) The Walshaw Dean Reservoirs seen from near the Pennine Way (a patchwork of burning is visible on the far slopes)

3.5 Peatland Condition

Where sites are not being assessed for built infrastructure, site surveys undertaken to support peatland restoration typically include peat depth surveys (equivalent to the Phase 1 probing described earlier) and peatland condition assessments (NatureScot, 2017). These latter assessments describe the degree to which a blanket bog or raised bog has departed from near-natural (or 'pristine') condition as a result of natural and human-made pressures, chiefly gullying, drainage, burning and grazing. Conditions are generally summarised as:

- **Near-natural condition:** *sphagnum* dominated, lack of evidence / impacts of burning, lack of evidence of grazing and trampling by stock, little or no bare peat surfaces, heather is not dominant.
- **Modified:** bare peat in small patches, evidence of current or historical fires, frequent impacts from grazing / trampling, *sphagnum* mosses bare or absent, extensive heather cover and undesirable levels of scrub.
- **Drained:** within 30m of either an artificial drain (grip) or a re-vegetated hagg / gully system).
- **Actively eroding:** active (bare and / or incising) eroding haggs / gullies, extensive

continuous bare peat surfaces (peat pans), extensive bare peat surfaces at former cutting sites, restoration may require de-stocking.

Approximately 1,290 ha (c. 55%) of the Peat Survey Area (2,352 ha) is within 30 m of artificial drains or haggs / gully systems, while much of the wider area shows ample heather, minimal *sphagnum* and evidence of fires and patchy bare peat. This will be quantified more thoroughly post-PEIR, but at this stage and on the basis of these categories, much of the Peat Survey Area can be characterised as Modified-Drained, and therefore in need of restoration.

While the WMECRP has undertaken drain blocking, over 11 years has elapsed since the last round of drain blocking (Walshaw Moor Estate and Natural England, 2017) and while water is now held within the drains, it has not generally recolonised with *sphagnum* and adjacent effects on vegetation have not resulted in widespread uplift of bog forming species (principally *sphagnum* mosses and cotton grass). Vegetation surveys documented in **Chapter 8: Biodiversity** of the PEIR and supporting technical appendices indicate much of the Turbine Area comprises degraded blanket bog, forms of wet and dry heath and acid grassland. Further restoration is therefore required to support recovery of the degraded blanket bog at the Turbine Area.

The next section provides a breakdown of anticipated peat excavation volumes associated with the Proposed Development infrastructure as a precursor to the reuse and restoration options described in Section 5.

4 Peat Excavation and Storage

4.1 Approach

4.1.1 Definitions

The majority of the infrastructure that forms part of the Proposed Development will require full excavation of the peat or soils underlying the infrastructure footprints during construction. However, some infrastructure is not required post-construction (i.e. into the operational and maintenance and decommissioning phases) and the peat excavated from these areas will be directly reinstated. In this section, the following terms are used to describe groundworks associated with peat / soil and wind farm infrastructure:

- **Permanently excavated:** peat will be permanently removed from the infrastructure footprint, stored and then reused elsewhere.
- **Temporarily excavated:** peat will be temporarily removed from the infrastructure footprint, stored locally and fully reinstated at the point of excavation post-construction.
- **Landscaping:** the process of using soils to 'dress' the boundaries of infrastructure by providing a rooting medium for plant growth which provides a visual ‘tie-in’ for infrastructure elements.
- **Restoration:** the use of excavated materials to improve the quality of land areas that are considered degraded through mechanisms other than those associated with wind farm construction (e.g. through peat cutting, erosion, quarrying); the term is not used to describe reinstatement activities at infrastructure.

4.1.2 Excavation Calculations

At PEIR, a simplified calculation has been undertaken in which the peat depth model is separated into soil (<0.3 m deep) and peat (≥0.3 m deep) and excavation volumes are calculated based on the product of the proposed infrastructure footprint and average soil or peat depth underlying it. Post-PEIR, once the design is frozen, more detailed calculations will be undertaken in which individual infrastructure components are split into areas overlying soil (<0.3 m depth) and areas overlying peat (≥0.3 m), with these latter areas further split into peat depth categories (0.5 - 1.0 m, 1.0 - 1.5 m, etc.) and an average depth calculated for each sub-area. The PEIR calculation is considered sufficiently representative to support assessment of whether a peat mass balance is achievable, as well as for providing information to undertake a preliminary assessment of the relative impacts associated with different infrastructure elements.

For each infrastructure item, for the purposes of the analysis, the upper 0.3 m of the peat profile is assumed to be acrotelm and any remaining depth is assumed to be catotelm. A 0.3 m thickness of turf and underlying peat is a sufficiently thick continuous layer to avoid damaging the roots of the excavated vegetation and provide a coherent ‘turf’ to relay.

4.1.3 Exclusions at PEIR

Aside from the calculation approach documented above, the approach outlined above for PEIR allows the identification of whether a peat mass balance can be calculated. While the total volume of peat is presented, the split of that material in reuse terms (in Section 5) as acrotelmic and catotelmic peat has not been calculated in detail, as this depends strongly on the final layout, feedback on the acceptability of the proposed reuse methodologies and target conditions for reuse and restoration areas.

Peat volumes excavated along the Access Routes and Bradford West Cable Corridor have not been included in the excavation calculations due to a lack of peat data obtained for these components at this stage.

In the associated report tables below, excavation figures are quoted to 1 m^3 to avoid rounding errors leading to inaccurate totals in later tables rather than to imply accuracy of calculations to 1m^3.

4.2 Results

4.2.1 Turbines, Hardstandings, Crane Pads and Lay Downs

Each turbine location will comprise a circular steel reinforced concrete turbine foundation set within a main crane hardstanding. The hardstanding will be constructed of aggregate and of fill construction, this aggregate replacing the underlying peat (which will be excavated and stored locally or taken to its ultimate destination for reuse).

Earthworks, either cut or fill, will be required to level the main hardstanding surface and achieve an appropriate tieback into the associated internal site access track(s). It is important to note that both cut and fill earthworks require the removal of underlying peat and soil.

Two secondary crane hardstandings will be constructed in line with the main hardstanding using similar construction techniques. Turning heads ('T'-shaped track sections) will be present at a number of turbine locations in order to allow the cranes to enter and exit the hardstanding areas. The main hardstandings will remain in place during the operational and maintenance phase to support routine maintenance and decommissioning.

On the opposing side of the access track to the turbine and main hardstanding, a blade laydown area and clearance areas will be required with associated cut or fill earthworks.

Plate 4.1 shows simplified footprints for these infrastructure elements and indicative dimensions.

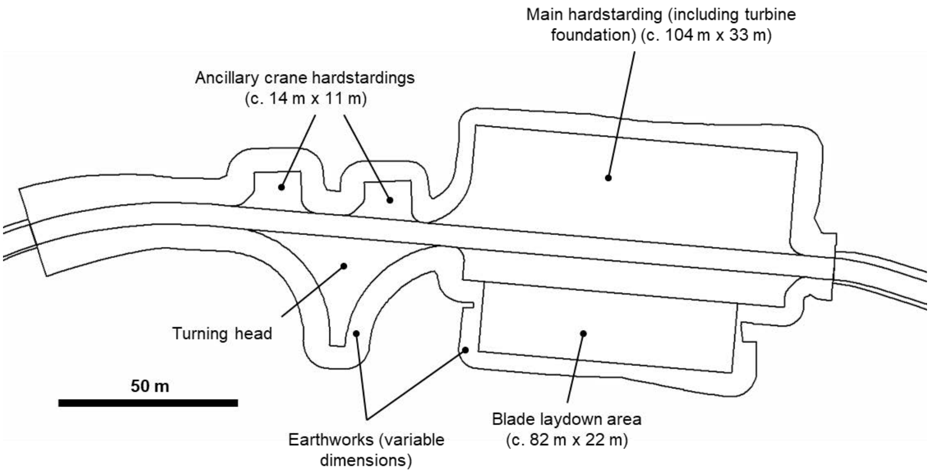

Plate 4.1 Indicative layout for turbines, hardstandings and track and indicative peat batter extent (see section 4.2)

Table 4.1 shows permanent and temporary excavations associated with the proposed infrastructure locations. Earthworks, which comprise a substantial proportion of the proposed infrastructure footprint are present around all infrastructure.

	Permanent Exc. Vol. (m^3)		Temporary exc. vol. (m^3)	
Infrastructure Type	**Peat**	**Soil**	**Peat**	**Soil**
Auxiliary Crane Pads	0	0	9,287	452
Batching Plant	0	0	0	120
Blade Storage Areas	0	0	33,104	2,763
Borrow Pits	0	0	41,098	3,116
Construction Compounds	0	0	2,991	655
Crane Hardstandings	53,956	6,573	0	0
Earthworks	222,827	12,139	68,581	2,531
Existing Track	0	0	0	0
Floated Track	0	0	0	0
Cut & Fill (Founded) Track	97,651	7,974	0	0
Substation	0	1,725	0	0
Turning Heads	12,623	567	0	0
Working Areas	0	0	17,527	1,707
Totals	**387,057**	**28,978**	**172,588**	**11,344**

Table 4.1 PEIR-stage estimated permanent and temporary excavation volumes of peat (undifferentiated) and soil

Table 4.2 shows a breakdown of volumes by turbine and other key infrastructure (including the crane hardstandings, ancillary crane hardstandings, blade storage areas (or fingers), working areas, turning heads, tracks internal to the hardstanding areas) and all earthworks associated with each turbine number. The mean probed depth of peat or soil associated with each turbine's overall footprint is also shown and is useful in understanding the relative impacts of each turbine. In summary:

- Only three turbine areas are proposed in peat depths averaging > 1.0 m – T10, T28 and T30 – given the extent of peat on the Turbine Area, this is evidence of effective layout planning in terms of the deepest peat present.
- The mean depth of peat across all turbine areas is c. 0.61 m, which is relatively shallow compared with peat depths at the Turbine Area as a whole.
- The 'maximum' average depth of peat impacted is c. 1.13 m at T28.

- The average volume of peat to be both permanently and temporarily excavated at each turbine location is c. 9,300 m^3.

It is expected that these volumes will reduce post-PEIR through further design refinement.

Figure 10.3.3 shows high level outlines of proposed infrastructure superimposed on the peat depth model (turbine locations are labelled). Outlines are shown to enable the probing locations and interpolated peat model to be clearly seen.

Turbine No.	Total Peat / Soil Volume (m^3)	Mean Probed Depth (m)	Turbine No.	Total Peat / Soil Volume (m^3)	Mean Probed Depth (m)
1	10,230	0.71	**18**	5,137	0.40
2	6,193	0.43	**19**	8,236	0.55
3	9,237	0.64	**20**	13,569	0.62
4	6,051	0.41	**21**	9,108	0.48
5	5,401	0.43	**22**	16,026	0.80
6	15,426	0.97	**23**	6,192	0.40
7	6,062	0.43	**24**	3,621	0.33
8	6,589	0.48	**25**	15,267	0.93
9	9,966	0.68	**26**	4,655	0.34
10	13,094	1.00	**27**	6,684	0.59
11	12,831	0.81	**28**	16,389	1.13
12	12,979	0.53	**29**	6,067	0.42
13	14,900	0.72	**30**	15,309	1.10
14	15,942	0.87	**31**	5,391	0.47
15	6,608	0.45	**32**	3,602	0.26
16	3,777	0.31	**33**	7,199	0.51
17	10,019	0.67	**34**	7,890	0.61

Table 4.2 PEIR stage estimated total permanent and temporary excavation volume and mean peat depth by turbine number

Current proposals at PEIR are for standard construction methodologies for turbines and hardstandings, i.e. cut and fill. The main hardstandings and turbine foundation footprints will be permanently excavated, while all other associated infrastructure (internal site access tracks excepted) will be temporarily excavated and reinstated.

Post-PEIR, additional mitigation opportunities are to be investigated, including:

- Floating blade laydowns and or shared laydowns (reducing the overall impact footprint).

- Rock displacement hardstandings (in which large diameter rocks are allowed to settle through the peat onto competent substrate and the running surface is placed on top).
- Reduced earthworks i.e. adopting steeper cut slopes and steeper fill gradients (to reduce earthworks footprints and peat excavation).

While piled foundations are occasionally proposed for wind farms, in which piles are pushed or drilled through the peat into underlying competent strata, the total vertical extent of piles (including pile caps and a load transfer platform) typically have a minimum height that in shallower peat may lead to a substantial amount of construction above ground. As noted, in section 3.2, the layout is relatively sympathetic to the distribution of peat on the Turbine Area in focusing on shallower areas and piled foundations are unlikely to be appropriate given peat depths currently affected.

4.2.2 Access Tracks

Access tracks comprise a c. 7 m wide running surface. These are of cut and fill or floated construction and the distribution of the proposed types is shown in **Figure 10-3.3**. Cut and fill tracks include associated earthworks on their margins (which also involve peat excavation), while any earthworks associated with floated track sections are simply an extension of the 'floated' surface.

Floating tracks involve no excavation, and therefore no peat is generated from this proposed infrastructure. Although termed 'floating', they do not literally float but use the tensile strength of the surface vegetation and underlying root mat to support the load of passing vehicles distributed over layers of geotextile and aggregate. Some settlement may be experienced but this mode of construction is typically preferred to cut and fill from an environmental perspective. Slope gradient limits the use of floating tracks to gradients < 5% or < 3° other than over very short distances on particular orientations (e.g. directly downslope) and therefore there may be areas where peat depths are suitable for floating tracks but slopes are not.

Excavation volumes associated with cut and fill (founded) track construction are shown in **Table 4.1**. All peat excavated from tracks will be permanently displaced and reused elsewhere.

It is recognised that the Western Access Route may involve excavation of peat, although peat depth data is not available for the full length of the route. An estimate of the peat depth along this route has been made to support an initial excavation volume and inform potential reuse requirements considered in Section 5.

Post-PEIR, there may be opportunities to use rock displacement construction techniques for some sections of track that are not suitable for floating (due to gradient) but are nevertheless on deep peat.

4.2.3 Cable Trenches

Cable trenches are to be excavated alongside access tracks within verges (i.e. the earthworks footprints) and any peat excavated prior to cable placement will be directly reinstated after installation. Therefore, peat disturbed in this activity is not considered in the overall peat mass balance calculations.

4.2.4 Construction Compounds

Construction compounds will provide storage for plant and materials and will be reinstated post-construction. Illustratively, three construction compounds are proposed, one of these being at the entrance to the Western Access Route. All compounds will be temporarily excavated to create a level surface temporarily excavated, with all excavated peat to be stored locally and reinstated. At PEIR, two of the compounds are sized at 5,000 m^3 and one at 3,000 m^2.

Table 4.1 shows excavation volumes associated with the construction compounds.

4.2.5 Substation

The substation compound will be permanently excavated to substrate over a footprint of 220 m x 160 m. The compound is located in an area without peat. Estimated soil volumes are shown in **Table 4.1**.

4.2.6 Borrow Pits

Five borrow pits are proposed to provide aggregate for the construction of tracks and hardstandings. The majority of these borrow pits are located within peat areas. **Table 4.1** shows calculated peat and soil volumes with borrow pits varying in dimension depending on their position in the landscape. All peat excavation from borrow pits will be temporary, and peat will be reinstated once the required aggregate has been extracted.

4.3 Summary of excavation volumes

The estimated total excavation volume of peat is c. 559,645 m^3 of which 387,057 m^3 will be permanently excavated and 172,588 m^3 temporarily excavated. Permanently excavated peat is treated as a surplus and must be reused in such a way that its ecosystem services are not compromised, or such that compensation for reduction in these services is more than achieved in habitat management proposals.

In addition to peat, c. 28,978 m^3 of soils (some of which will be organic soils or shallow peaty soils) will be permanently excavated and c. 11,344 m^3 temporarily excavated. It is anticipated at PEIR that the soil fraction will be used in landscaping / tying in infrastructure rather than peat. As noted in section 4.2.1, through further design refinement, it is possible that both the overall volume of peat to be excavated (permanently and temporarily) will reduce and that the proportion of peat directly reinstated rather than reused elsewhere will increase. Opportunities to achieve this follow will arise from both layout design and adjustments to construction methodologies.

The next section considers how the likely worst-case volumes presented here, at PEIR, may be reused to minimise loss of functionality of the displaced peat.

5 Peat Reuse

5.1 Approach

Excavated peat will be re-used in:

1. Reinstatement of temporary excavations for infrastructure.
2. Peatland restoration.

The following sections describe the approaches above as applied in terms of options for the Proposed Development at PEIR.

5.2 Reinstatement of Temporary Excavations for Infrastructure

5.2.1 Turbine Areas

All temporary infrastructure will be reinstated with the peat excavated from their respective footprints. It is anticipated that this will include all peat underlying blade storage areas (or fingers) and associated working / clearance areas, ancillary crane pads and the temporary earthworks enabling the construction of these footprints. At PEIR, detailed reinstatement plans have not been prepared for each turbine, however, these will be prepared following design freeze to provide an accurate reinstatement volume for each turbine and this will be presented in the ES.

Peat will also be reinstated into the temporary construction compounds and borrow pits although to a greater depth than originally excavated.

Table 5.1 shows the reinstatement volumes calculated for PEIR based on these assumptions.

Infrastructure Type	Peat Volume to be Reinstated (m^3)
Auxiliary Crane Pads	9,287
Blade Storage Areas	33,104
Working Areas	17,527
Earthworks (Temporary)	68,581
Total	**128,499**

Table 5.1 Peat volumes estimated to be reinstated within turbine areas

Reinstatement will be undertaken by removing the aggregate used to support constructed surfaces, levelling, and where necessary adding a moisture retentive liner (ideally locally derived clay) before placing catotelmic peat and then acrotelmic peat (including vegetated turves).

5.2.2 Borrow Pits and Compounds

It is common practice in onshore wind farm construction in the UK to utilise borrow pits for peat reuse since i) they provide centralised areas in which larger volumes can be reinstated in a single location, ii) they are connected to existing access routes, and iii) by their nature, they form natural low points in the landscape suitable for collecting moisture and therefore are good long-term locations for peat. In Scotland, it is generally the case that up to 2.0 m of peat placement is considered acceptable with depths exceeding this treated as waste. Compounds may also be used for peat reuse, particularly where lower lying in the landscape.

At PEIR, it is proposed to reinstate peat up to 2.0 m depth in the five borrow pits and three compounds footprints specified as part of the Proposed Development. The capacity of these infrastructure locations depends on the average depth of material excavated prior to their construction. **Table 5.2** shows available reinstatement depths and anticipated reinstatement volumes for the borrow pits and compounds.

Borrow Pit / Compound	Peat Volume to be Reinstated (m^3)	Additional capacity (m^3)	Total Volume (m^3)
BP1	10,508	34,724	45,232
BP2	8,703	21,313	30,016
BP3	350 (est.)	23,965	24,315
BP4	10,793	19,299	30,092
BP5	10,744	46,716	57,460
CC1	-	1,500	1,500
CC2	1,204	8,796	10,000
CC3	1,787	8,223	10,000
Total	**44,089**	**164,536**	**208,615**

Table 5.2 Reinstatement capacities in borrow pits and compounds

Due to the volumes and footprints involved, the borrow pits may require reinstatement using internal bunds to help retain peat. Bunds would be constructed over an impermeable layer (for moisture retention) and comprise large grade aggregate (e.g. site derived rock). Acrotelmic peat would not be separated by bunds in order to enable surface water flows to move across the reinstated surface.

Subsequent to PEIR, reinstatement profiles will be generated for each borrow pit and compound included in the final peat reuse proposals.

5.3 Peatland Restoration

Where peat is reused to help reverse degradation of peatlands caused by previous natural erosion processes and management impacts, it can be considered restoration, provided that the outcomes achieve an improvement in peatland condition. Four opportunities have been identified to support peatland restoration using peat excavated from infrastructure locations. These are considered below.

5.3.1 Restoration of Peat Cuttings

There are extensive peat cuttings in the south and east of the Turbine Area, many of them in close proximity to the proposed infrastructure locations. LiDAR data indicate that typical cut depths are in the c. 0.3 to 0.5 m depth range such that the cutover surfaces sit below the prevailing peat surface, contributing to dewatering of the residual, original peat surface. The cutting footprints often comprise degraded bog vegetation relative to higher quality peatland in the surrounding areas.

Cuttings have been mapped across the Turbine Area and those falling adjacent to proposed infrastructure locations have been highlighted for peat translocation to support their restoration. Cuttings on moderate slopes or near watercourses have been excluded. **Figure 10-3.4** shows cutting locations identified for peat reuse. At PEIR, an average translocation depth of 0.4 m has been used to calculate reuse volumes. This will be refined specific to each cutting area once the design has been fixed for the ES and final excavation metrics are understood.

Depending on the quality of vegetation present within each cutting, existing vegetation will be rolled back, peat placed and the temporarily displaced vegetation replaced. If vegetation is of poor quality than available turves excavated from nearby infrastructure, the higher quality vegetation will be placed. Impermeable liners will only be introduced if cutting floors are bare. If appropriate, a low mineral berm will be constructed on the downslope side of the cutting to help retain water in the translocated area.

Table 5.3 shows estimated peat volumes associated with this reuse method.

Description	Area (ha)	Depth (m)	Volume (m^3)
Peat cuttings	18.9	0.4	75,639

Table 5.3 Reinstatement capacities in peat cuttings

Benefits will include increased resilience of the residual intact peat through recovery of the former peat depths present in these areas, reducing the extent to which they have dewatered, reduced oxidation of cutting sidewalls (due to buttressing by placed peat), and where higher quality vegetation is placed within the cuttings, better peatland condition.

5.3.2 Restoration of Dikes

Dikes form trough shaped landforms in the mid-slopes of various parts of the Turbine Area, and are almost certainly responsible in part for some of the larger gullies that have eroded the middle and upper slopes on Widdop Moor and below Dick Delf Hill. These are disruptive forms of land drainage and have had a negative net effect on the peatland at the Turbine Area.

Peat will be placed into the dikes until level with the prevailing ground surface, with mineral bunds used to retain these materials in cells along the dike axis. **Table 5.4** shows anticipated peat restoration volumes associated with this reuse method. **Figure 10-3.4** shows the dike locations.

Location	Area (m^2)	Target Depth (m)	Volume (m^3)
Cross Dike (east)	11,679	0.29	3,330
Cross Dike (west)	21,911	1.14	25,061
Unnamed Dike	27,386	0.58	15,964

Location	Area (m^2)	Target Depth (m)	Volume (m^3)
Total	-	-	**44,355**

Table 5.4 Reinstatement capacities in dikes

Reinstated peat within the dikes will help preclude further erosion of the gullies that drain into them and will reinstate the former peat surface that would have been present prior to the dikes being cut. Hydrological continuity will be improved across the former dike footprint. In tandem with gully restoration, this may help to support expansion of higher quality blanket bog in the west of the Turbine Area.

5.3.3 Restoration of Pits / Quarries

There are at least 11 pits or mineral extraction locations across the Turbine Area, some of which are located close to the proposed infrastructure locations and which would formerly have had peat cover. While the potential reinstatement volumes associated with their restoration isn't large, their presence as voids within a wider peatland setting may compromise the surrounding areas. Three locations have been identified for peat reuse (see **Figure 10.3.4**).

Table 5.5 shows indicative reuse volumes at each location.

Description	Area (ha)	Depth (m)	Volume (m^3)
Pits / quarries	0.22	1.5	3,282

Table 5.5 Reinstatement capacities in pits / quarries

Reinstated peat will increase hydrological connectivity across their footprints and reduce dewatering effects associated with the voids.

5.3.4 Restoration of Gullies

The Turbine Area has been subject to extensive gully erosion (see **Figure 10-3.4**), with some gullies exceeding 20 m in width and 4 m in depth. While many of these gullies are situated away from proposed infrastructure locations, some are directly traversed by the proposed internal site access tracks or overlapped by infrastructure footprints. Where this is the case, translocation of peat into the gully floors may be possible. At PEIR, this remains a reuse concept pending the final design layout and will be reported on in the ES. It is anticipated that this reuse method will provide positive outcomes, sealing bare peat sides and reinstating the former peat surface.

5.4 Peat Storage Area

Because the volume of peat calculated to be excavated at PEIR exceeds the available capacity from reuse and restoration described above, an additional peat storage area (PSA) has been identified in the centre of the Turbine Area in an area that has largely lost its peat cover following historical enclosure of the lower slopes. The area is located in the loop of a proposed track connecting proposed turbines T16 and T18 and patchy peat cover indicates that there was likely deeper peat here in the past.

The principles of peat storage will follow those for the borrow pits and compounds, with mineral bunds providing cells over the footprint of the PSA and peat being placed to between 1.0 and 1.5 m depth in this area. Existing stone walls running downslope will be incorporated in the cell bund design.

The location of the PSA is shown in **Figure 10-3.4** and the total anticipated volume of peat to be reused in this area is shown in **Table 5.6**.

Description	Area (ha)	Depth (m)	Volume (m^3)
Peat Storage Area	7.1	1.0 - 1.5	99,386

Table 5.6 Reinstatement capacity in PSA

The PSA is regarded as the least preferred of the reuse options proposed in the PMP since it is not genuine restoration, and opportunities to reduce the extent to which it is required or reduce the proposed depths of translocation will be investigated further post-PEIR.

5.5 Soil Reuse and Landscaping

Section 4 indicated that 40,322 m^3 of soil would potentially be excavated during construction of the proposed layout (permanent and temporary). These soils are typically in areas where peat is absent entirely, where peat was formerly present but deposits have thinner or degraded over time or where shallow peaty soils form a mosaic with peat and are functionally linked.

A volume of soil is required to form a rooting medium on the edges of any permanent infrastructure remaining in place during operation (e.g. the edges of cut and fill internal site access tracks, the margins of the main hardstandings at turbines). It is proposed that where these structures are retained, their aggregate surface is dressed with less sensitive soils and vegetated turves with species tolerant of drier conditions are used for landscaping. The exception would be areas adjoining peatland and fed by surface water from peat areas (which would be expected to remain wetter and therefore retain wetter species).

Again, the specific calculations associated with this reuse measure will be undertaken post-PEIR following design freeze. The total earthwork footprint for infrastructure within the Turbine Area is c. 510,000 m^2 or 51 ha. The total permanent soil excavation associated with construction is c. 28,978 m^3 (c. 40,322 m^3 if temporarily excavated soil were to be used for landscaping and not reinstated at source in order to create room for peat). This equates to an average landscaping depth of between 5 and 10 cm, and would therefore not be excessive.

5.6 Peat Mass Balance

The PEIR stage peat mass balance for the Proposed Development can be simply expressed as the total excavation volume minus the total reuse volume. Where this volume is positive, there is a peat surplus, i.e. more peat is excavated than can be reused. Where the volume is negative there is a shortfall and more peat is required for reuse than is available. **Table 5.7** summarises the PEIR stage calculation based on the excavation volumes and reuse measures described in this report.

Description	Volume (m^3)
Excavation	
Permanent (from Table 4.1)	387,057
Temporary (from Table 4.1)	172,588
Total Excavation	**559,645**
Reinstatement / Reuse	
At turbines (from Table 5.1)	128,499
At borrow pits and compounds (from Table 5.2)	208,615
Within peat cuttings (from Table 5.3)	75,639
Within dikes (from Table 5.4)	44,355
Within pits / quarries (from Table 5.5)	3,282
Within Peat Storage Area (from Table 5.6)	99,386
Total Reuse	**559,776**
Balance (Total Excavation – Reinstatement / Reuse)	**-131**

Table 5.7 Estimated peat mass balance at PEIR

The reported -131 m^3 represents a minor shortfall, and is <0.5% of the total permanent and temporary peat excavation volumes calculated in Section 4. At PEIR, this represents a worst-case rather than best estimate, mainly because the expected excavation volume is likely to reduce due to further design refinement for the ES.

This value indicates that all peat excavated could be reused within the Turbine Area both in reinstatement of temporary infrastructure and in positive restoration of peatlands already in degraded condition.

Section 6 of the report provides high-level information on good practice measures to be undertaken prior, during and post-construction. These will be refined to be specific to the final peat excavation and reuse proposals subsequent to design-freeze and will be reported in the ES.

6 Good Practice

6.1 Background

Good practice measures in relation to peat excavation and reuse are now generally well defined following a number of years of practice (at wind farm sites) across the UK and Ireland.

The sections below outline good practice measures related to excavation and handling, storage, and reinstatement and restoration of peat in association with wind farm construction.

6.2 Excavation and handling

The following good practice measures are proposed for excavation and handling:

- A minimum thickness of 300 mm of acrotelmic peat or turved organic soil should be excavated where sufficient soil is present; where less than 300 mm is present, the full depth of soil and surface vegetation should be excavated.
- Excavation and transport of peat/soil shall be undertaken to avoid cross-contamination between soil horizons (e.g. organic soil and underlying mineral soil / substrate).
- Where possible, cross-tracking of plant over undisturbed vegetation should be minimised, and excavated materials transported to their storage locations along internal site access tracks.
- If working is required away from internal site access tracks, the use of long reach excavators should be encouraged in order to minimise cross-tracking.
- If landscaping of road / track margins is required for temporary works, it is preferable for vegetated organic soils to be used for this purpose rather than acrotelmic peat (which should be stored).
- Wherever possible, double handling of peat should be minimised (in particular for catotelmic peat) by direct transport of materials to their point of storage.

6.3 Storage

The following good practice measures are proposed for storage:

- Eliminate storage where possible by single handling from the point of excavation to a location of reuse.
- If storage cannot be avoided, minimise storage time by taking a holistic approach to excavation and restoration such that catotelmic peat (in particular) is used as soon as possible after excavation.
- Store excavated acrotelmic and catotelmic peat separately during excavation works, which will be undertaken by an experienced contractor specialising in peat groundworks and restoration.
- Acrotelmic peat and turved soil blocks should be stored turf side up to prevent damage to vegetation.

- Storing in areas of minimal gradient where 'runoff' or drainage away from the point of storage is minimised (these areas will also satisfy to avoid areas of lower stability)
- Fewer, larger stores will be preferable to a greater number of small stores, since the total potential area of drying surface will be less.
- Where storage is required in the medium term, preparing the peat to minimise the surface exposed to drying (e.g. through blading off of catotelmic peat and use of appropriate cover to minimise moisture loss).
- The Ecological Clerk of Works (ECoW) should work with an appointed Geotechnical Engineer (GE) to review the placement and condition of stored peat.
- Any PSAs should be outside any area identified in the PLHRA (**Appendix 10-4**) as of 'Moderate' or greater likelihood) and should be more than 50 m away from watercourses, away from sensitive habitats and away from the edge of excavations.
- Peat and soil stores should be appropriately bunded to prevent risks from material instability and prevent runoff of sediment and water from the stockpiles
- The condition of the excavated peat, in particular its moisture content, should be regularly monitored and local water utilised to periodically 'refresh' stored peat and prevent desiccation.
- A Sustainable Drainage System (SuDS) should be implemented to control water and sediment loss during storage (this also applies to reinstated areas, see below).

6.4 Reinstatement and Restoration

The following good practice measures are proposed for reinstatement and restoration:

- Where possible, turves and underlying catotelmic peat should be reinstated at the locations from which they were removed.
- Any bare peat exposed at the surface of a reinstated area should be seeded with a seed mix or translocated vegetation appropriate to the locality.
- Where insufficient turves are available to full cover reinstated soils, a checkerboard pattern of turf blocks should be used, with turf squares no less than 1 m^2 to act as seed points interspersed amongst the bare areas.
- Reinstated ground levels should tie in with the surrounds, and any bulking up should be avoided by tamping down soils and turves.
- If appropriate, temporary fencing may be required to enable vegetation to establish following reinstatement works and prevent damage by livestock, deer or rabbits.

6.5 Monitoring

During construction, monitoring should be undertaken in any areas where peat is stored, as follows:

- Regular visual inspection of the outer peat surface of any stored peat to identify any evidence for drying or cracking.

- Regular coring of stored peat to log the moisture content of stored peat (using the von Post scale to monitor changes in moisture content for peat on the outside and within the peat mound).
- Clear specification of an action plan in response to these observations, including modifications to coverings, implementation of watering, or construction of temporary berms to retain water in the storage footprint.
- Acceleration of re-use for vulnerable stores if so identified.

Key to the success of the strategy for peat management will be careful monitoring of the post-construction works and any reinstatement/restoration activities. A monitoring programme should be initiated once restoration and peat reinstatement works have been completed, and should include:

- Review of % vegetation cover and vegetation composition in areas of bare peat that have been reinstated or in any areas that have been seeded (due to a lack of available turved material).
- Review of stability of deposits in their new locations.
- Fixed point photography in order to aid review over a series of monitoring intervals.

If required, mitigation recommendations should follow from the monitoring and include:

- Specification of seeding appropriate to the target vegetation or stabilisation with geotextile if revegetation is not occurring naturally (which will assist re-wetting and retention of moisture contents).
- Construction of wood dams (or equivalent) if any creep of peat soils is evident at any restored location.

Monitoring should be carried out for a minimum of five years after construction and reinstatement works have concluded.

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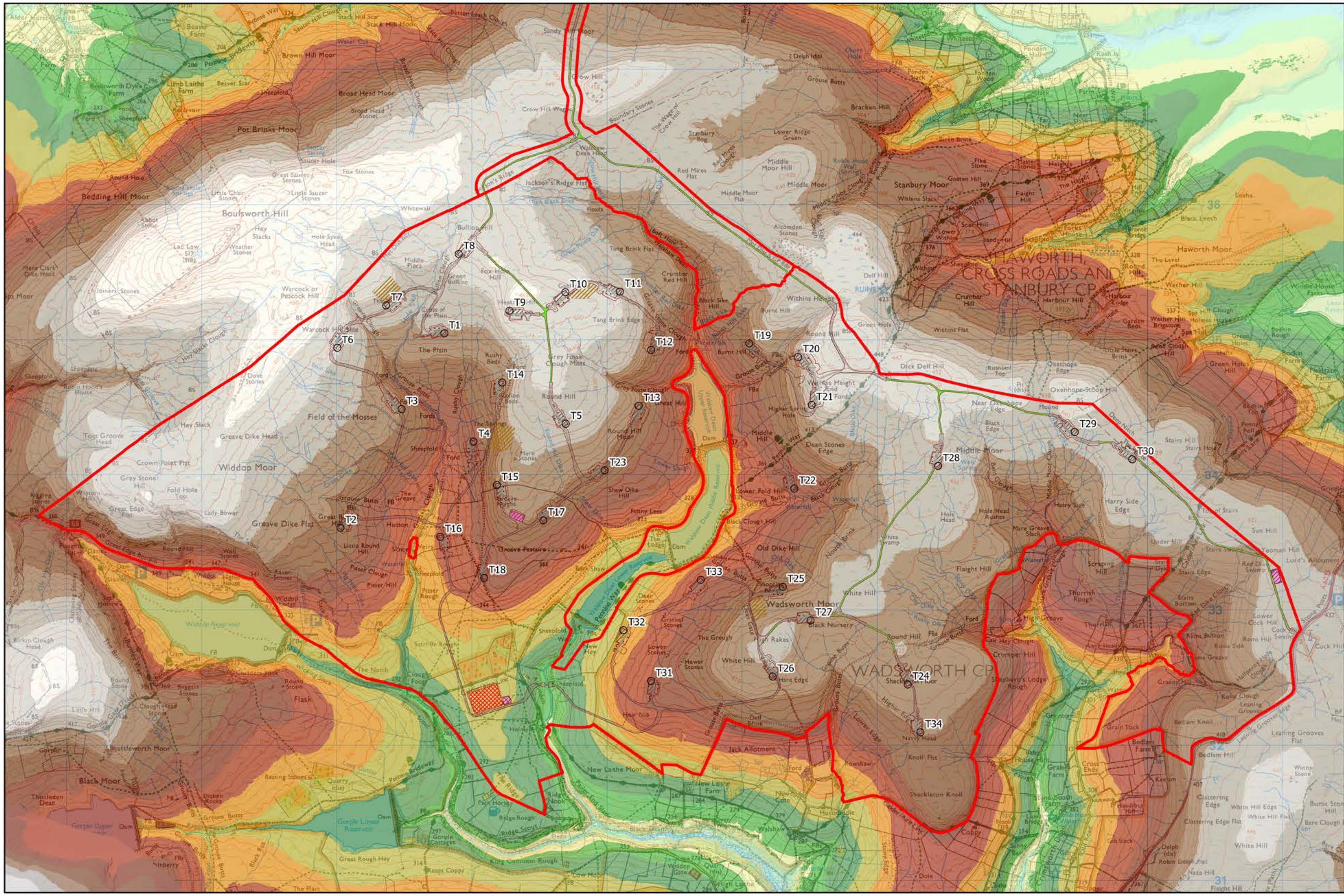


Legend

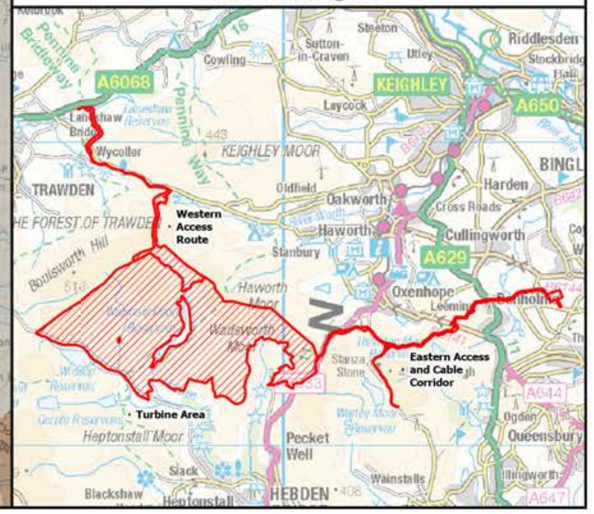
PEIR Boundary	
Proposed turbines	
Proposed layout	
Auxiliary Crane Pads	
Batching Plant	
Blade Storage Areas	
Borrow Pit	
Construction Compound	
Crane Hardstandings	
Earthworks	
Floated Track	
Other tracks and turning heads	
Substation	
Working Area	

Elevation (m)

- < 220
- 220 - 240
- 240 - 260
- 260 - 280
- 280 - 300
- 300 - 320
- 320 - 340
- 340 - 360
- 360 - 380
- 380 - 400
- 400 - 420
- 420 - 440
- 440 - 460
- 460 - 480

0 250 500 1,000 1,500 2,000 m

Scale: 1:30,000 @ A3



GENERAL NOTES:

1. This drawing is to be read in conjunction with all engineer's, architect's or other relevant drawings and specifications.
2. All dimensions and levels are subject to detailed design.
3. All works to be carried out in compliance with the requirements of the relevant statutory authorities and regulations.

Drawing Notes

The site boundary is for indicative purposes only and requires confirmation on site.

Revision History

Rev	Date	Detail
01	30/01/2026	First Revision
02	27/02/2026	Second Revision
03	07/04/2026	Third Revision

Project/Location

Calderdale Energy Park
Outline Peat Management Plan (PEIR)

Drawing title

Elevation

Drawing status

FOR INFORMATION

Client

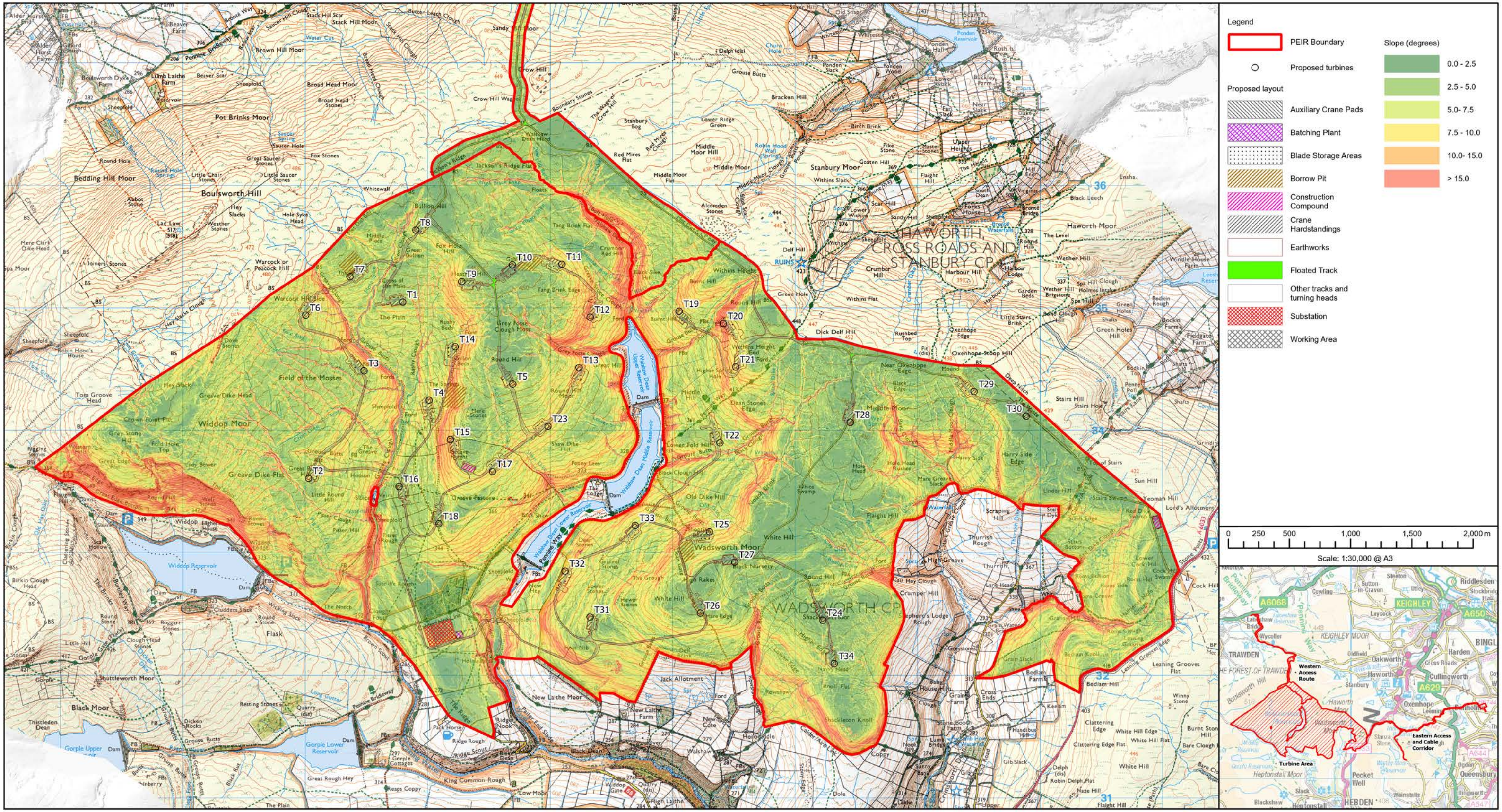
Calderdale energy park

Consultant

OWC An ABL Group Company

Drawing Number

Figure 10.3.1



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03	07/04/2026	Third Revision

Project/Location

Calderdale Energy Park
Outline Peat Management Plan (PEIR)

Drawing title

Slope Angle

Drawing status

FOR INFORMATION

Client

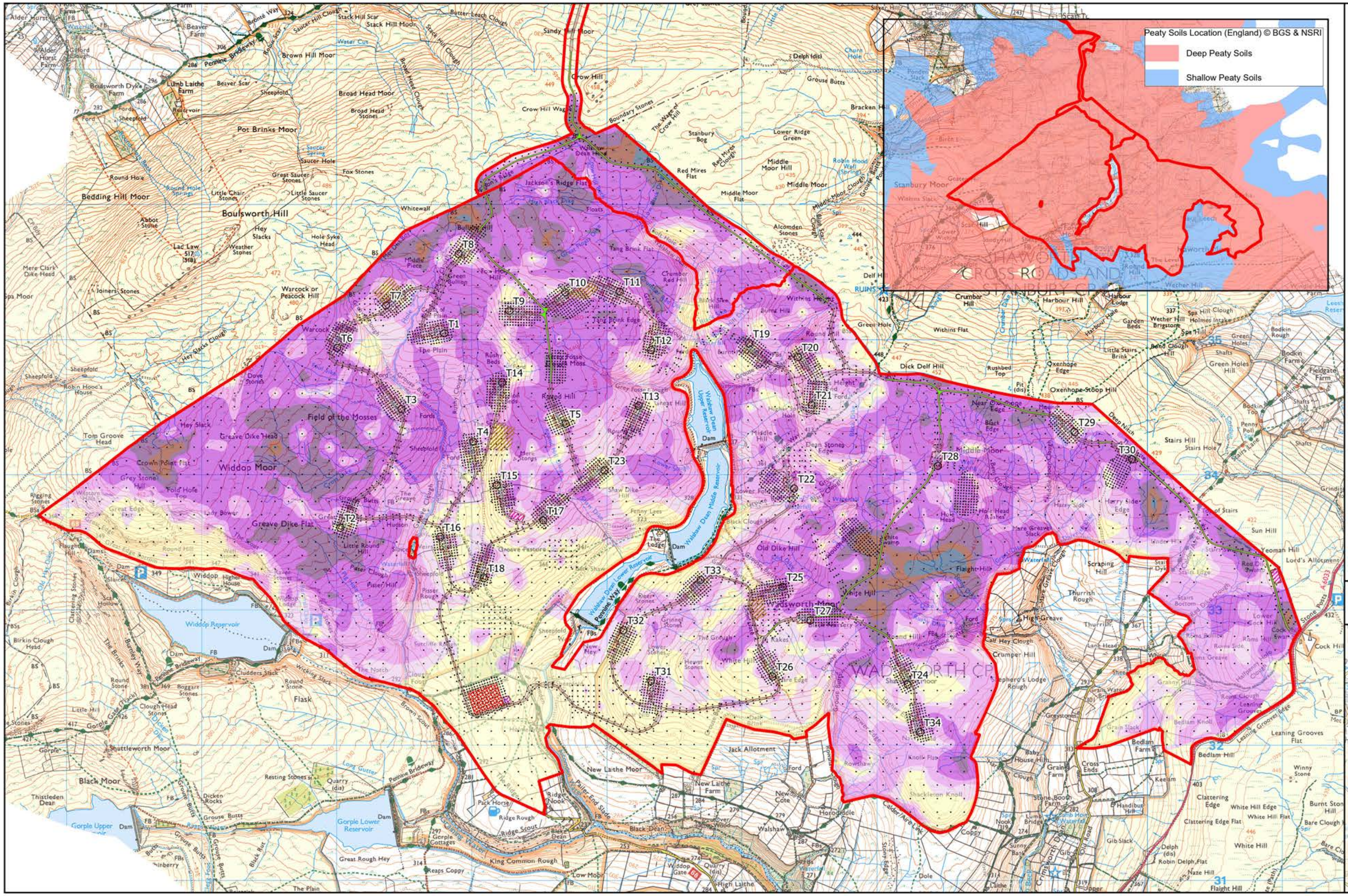
Calderdale energy park

Consultant

OWC An ABL Group Company

Drawing Number

Figure 10.3.2



Legend

- PEIR Boundary

Proposed layout

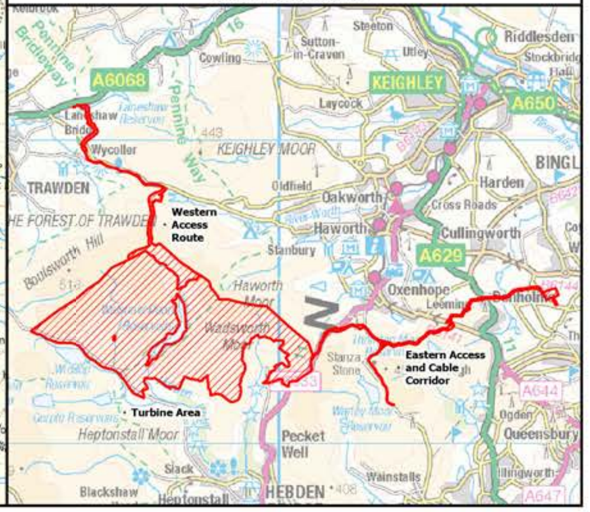
- Auxiliary Crane Pads
- Batching Plant
- Blade Storage Areas
- Borrow Pit
- Construction Compound
- Crane Hardstandings
- Earthworks
- Floated Track
- Other tracks and turning heads
- Substation
- Working Area
- Peat probe locations

Peat depth (m)

- 0.0 - 0.3 (Soil)
- 0.3 - 0.5 (Peat)
- 0.5 - 1.0 (Peat)
- 1.0 - 2.0 (Peat)
- 2.0 - 3.0 (Peat)
- 3.0 - 4.0 (Peat)
- >4.0 (Peat)

0 250 500 1,000 1,500 2,000 m

Scale: 1:30,000 @ A3



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Revision History

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02	27/02/2026	Second Revision
03	07/04/2026	Third Revision

Project/Location

Calderdale Energy Park
Outline Peat Management Plan (PEIR)

Drawing title

Peat Depth

Drawing status

FOR INFORMATION

Client

Calderdale energy park

Consultant

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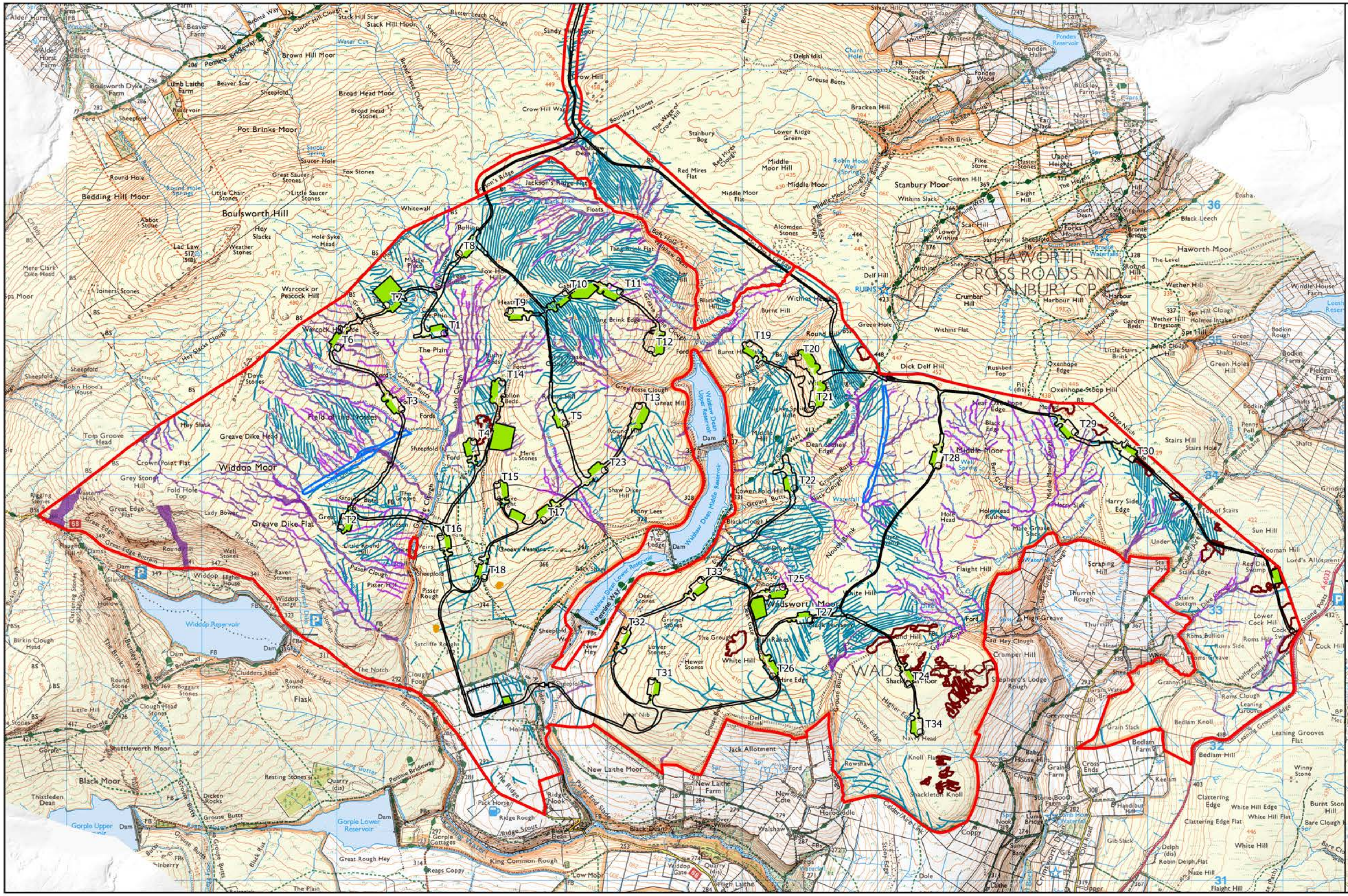
Drawing Number

Figure 10.3.3

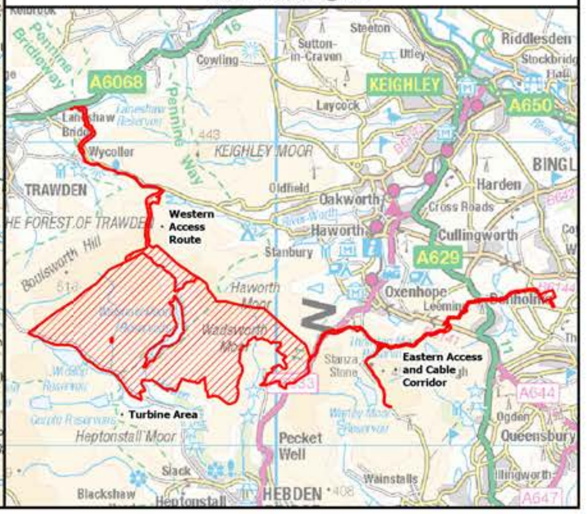


Legend

- PEIR Boundary
- Proposed turbines
- Layout footprint
- Artificial drains
- Temporarily excavated and reinstated
- Cuttings for peat reuse
- Dikes for peat reuse
- Pits for peat reuse
- Gullies

0 250 500 1,000 1,500 2,000 m

Scale: 1:30,000 @ A3



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Drawing Notes

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Revision History

Rev	Date	Detail
01	30/01/2026	First Revision
02	27/02/2026	Second Revision
03	07/04/2026	Third Revision

Project/Location

Calderdale Energy Park
Outline Peat Management Plan (PEIR)

Drawing title

Peat reuse and reinstatement, drains and gullies

Drawing status

FOR INFORMATION

Client

Calderdale energy park

Consultant

OWC An ABL Group Company

Drawing Number

Figure 10.3.4

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