Technical Appendix 9.1: Peat Landslide Hazard Risk Assessment

Clune Wind Farm

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Basis of Report

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1.0 Introduction

1.1 General

SLR Consulting Ltd (SLR) was commissioned by Renewable Energy Systems Ltd (RES) to undertake a Peat Landslide Hazard and Risk Assessment (PLHRA) for the proposed Clune Wind Farm (the Proposed Development). The location and layout of the Proposed Development are detailed on **Figure 9.1.1** and **Figure 9.1.2** with the red line boundary defining 'the Site'.

The purpose of this report is to consider the extent of peat and potential peat slide hazard at the Proposed Development and consider the potential impact to any development, such that areas of deep peat and areas at high risk of a peat slide can be avoided during the design phase. Further consideration is given to stability risks due to construction of the development and potential risks to receptors in a across the Proposed Development.

The assessment has been undertaken in line with best practice guidance[1,2] issued by the Scottish Government for investigation, assessment and reporting for wind farms in peat areas. Where relevant, reference is also made to guidance published by the Scottish Environment Protection Agency (SEPA) and wind farm construction good practice guidance.

The work has been undertaken by a team of Geotechnical Engineers and Geologists, with over 10 years' experience in undertaking peat assessments. The team was led by a Chartered Hydrogeologist with 30 years' consultancy experience and specialising in the assessment of soils, geology and water for renewable power projects in Scotland.

1.2 Scope and Objectives of Report

The purpose of a report is to identify those areas of the Proposed Development that are naturally susceptible to a higher risk of instability so that they can be avoided or accommodated during the design phase. It should be noted that all peat slopes have a risk of instability and the vast majority of peat slope failures occur naturally.

The peat stability assessment is primarily concerned with the influence of the peat on the development of the wind farm. The main objective is to assess the potential peat stability at the Proposed Development, identify areas of potential concern and identify mitigation measures to ensure the maintenance of peat stability before, during and after construction. All aspects of construction should be based on ensuring minimum disruption to the peat areas. The objectives have been achieved by completion of the following:

- A desk-based review of available reports which include geological, hydrological and topographical information;
- Reconnaissance visit;
- Peat depth surveys;
- Geomorphological mapping of the Proposed Development to identify the prevailing conditions influencing the potential for, or any evidence of, active, incipient or relict peat instability, including identification of the location and photographic record, as appropriate;

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[1] Energy Consents Unit Scottish Government. (April 2017) Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments. Second Edition.

[2] Scottish Government, Scottish Natural Heritage, SEPA. (2017) Peatland Survey. Guidance on Developments on Peatland, on-line version only. Accessed 20/09/2024.

- Reporting on evidence of any active, incipient or relict peat instability, and the potential risk of future instability, describing the likely causes and contributory factors;
- Identification of potential controls to be imposed on the Contractors for the works to minimise the risk of peat instability occurring at the Proposed Development; and
- Provide recommendations for further work or specific construction methodologies to suit the ground conditions at the Proposed Development to mitigate any unacceptable risk of potential peat instability.

Construction of the development would only increase the risk of peat slope instability if good geotechnical construction practice is ignored and it is a requirement of all renewable energy developments to follow a very carefully worded and designed Construction and Environmental Management Plan (CEMP) which uses many of the recommendations of the PLHRA.

Without the guidance contained in a Construction Method Statement or CEMP, the following factors would increase the risk of instability:

- Construction of access tracks;
- Excavation and stockpiling for foundations;
- Construction of hardstanding area; and
- Blocking of natural drainage, inappropriate new drainage, or drainage discharge.

It is important to note that peat instability and the impacts of any instability are not constrained by artificial site or ownership boundaries but by topographic and geomorphologic boundaries. It is therefore important to ensure that the breadth of scope of any assessment adequately covers the areal extent of possible impact.

The risk assessment is based on ground models developed using a Geographical Information System (GIS) specifically for this Proposed Development. A numerical analysis was undertaken in which coefficients were allocated for each of the factors influencing peat stability.

This system outlined above was developed in accordance with the guidelines on PLHRA by the Scottish Government[1] for the investigation, assessment, and reporting for wind farms in peat areas. The analysis and interpretation are based upon the results obtained from this process as well as previous experience and the results of case studies elsewhere. Where deviations from this guidance have occurred, this is highlighted and explained in the text.

2.0 Peat Instability

The importance of assessing the stability of peat deposits in relation to wind farm developments came to the fore as a result of peat failures during the construction of Derrybrien[3] Wind Farm in Ireland in 2003. Although no fatalities were associated with these failures, there was a significant environmental impact. Wind farms tend to be constructed in upland areas which may be associated with significant peat deposits (typically blanket bogs). There is a potential for peat instability to occur, particularly where deposits are in excess of 1m thick. Peat instability is influenced by many factors, including, but not limited to, peat thickness, hill slope gradient, underlying geology and subsurface hydrology.

This section reviews the nature of peat and how current and past activities can influence stability. The factors which are likely to influence the potential for peat instability are:

- Significant peat depths over impermeable bedrock or minimal soil;
- The presence of slope gradients greater than 4° (approximately) and general topography;
- Natural drainage paths;
- Evidence of past failures, including soil creep;
- Drainage features at the base of slopes which could lead to undercutting;
- Forestry plantations and artificial drainage and recent climate patterns;

It should be noted that peat instability is not a recent phenomenon and there is documentary evidence of peat landslides dating back over 500 years[4]. Many landslides that involve peat have no human interference that could be considered as a trigger, and this should be borne in mind when considering the susceptibility of a site to potential instability.

2.1 Background Information Regarding Peat

Peat is found in extensive areas in the upland and lowland regions of the UK and is defined as the partly decomposed plant remains that have accumulated in-situ, rather than being deposited by sedimentation. When peat forming plants die, they do not decay completely as their remains become waterlogged due to regular rainfall. The effect of water logging is to exclude air and hence limit the degree of decomposition. Consequently, instead of decaying to carbon dioxide and water, the partially decomposed material is incorporated into the underlying material and the peat 'grows' in-situ.

Peat is characterised by low density, high moisture content, high compressibility and low shear strength, all of which are related to the degree of decomposition and hence residual plant fabric and structure. To some extent, it is this structure that affects the retention or expulsion of water in the system and differentiates one peat from another.

Lindsay[5] defined two main types of peat bog, raised bog and blanket bog, which are prevalent on the West coast of Europe along the Atlantic seaboard. In Britain, the dominant peatland is blanket bog which occurs on the gentle slopes of upland plateaux, ridges and benches and is predominantly supplied with water and nutrients in the form of precipitation. Blanket peat is usually considered to be hydrologically disconnected from the underlying mineral layer.

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[3] Lindsay, R.A. and Bragg, O., (2004), 'Windfarm and Blanket Peat, The Bog Slide of 16th October 2003 at Derrybrien, Co. Galway, Ireland'. University of East London

[4] Smith, L.T., (Ed) (1910), 'The literary of John Leland in or about the years 1535-1543.' Vol.5, Part IX. London: AF Bell and Sons.

[5] Lindsay, R.A., (1995), 'Bogs: The ecology, classification and conservation of Ombrotrophic Mires.' Scottish Natural Heritage, Perth.

There are two distinct layers within a peat bog, the upper acrotelm and the lower catotelm. The acrotelm is the fibrous surface to the peat bog[6], typically less than 0.5m thick, which exists between the growing bog surface and the lowest position of the water table in dry summers. Below this are various stages of decomposition of the vegetation as it slowly becomes assimilated into the body of the peat.

For geotechnical purposes the degree of decomposition (humification) can be estimated in the field by applying the 'squeezing test' proposed by von Post and Grunland[7] (1926). The humification value ranges from H1 (no decomposition) to H10 (highly decomposed). The extended system set out by Hobbs[8] provides a means of correlating the types of peat with their physical, chemical and structural properties.

The relative position of the water table within the peat controls the balance between accumulation and decomposition and therefore its stability, hence artificial adjustment of the water table by drainage requires careful consideration.

2.1.1 Peat Shear Strength

In geotechnical terms, the shear strength of a soil is the physical characteristic that provides stability and coherence to a body of soil. For mineral soils such as clays or sands, such strength is variously given by an inter-particle friction value and cohesion. Depending on whether the mineral soil is predominantly cohesive (clay) or non-cohesive (sand) governs which of the components of strength control the behaviour of the soil.

For peat soils, where the major constituent is organic and there is likely to be little or no mineral component, the geotechnical definition of shear strength does not strictly apply. At present there is no real alternative method for defining the shear strength of peat, therefore the geotechnical definition is generally adopted, in the knowledge that it should be used with great caution.

As noted previously, the acrotelm or near surface peat comprises a tangle of fresh and slightly rotted roots and vegetable fibres. These roots and fibres impart a significant tensile shear strength capacity to the material which provides it with a significant load carrying capacity. The acrotelm is, in effect, a fibre reinforced soil.

In the more decomposed catotelm, the tensile shear strength is reduced as the roots and fibres become more rotted. However, the loss in strength due to decomposition is offset to a limited degree, by a gain in strength due to the overburden pressure. In geotechnical engineering there is an established relationship for recently deposited soils, between the shear strength of a sample and the thickness of overburden above it.

Consequently, it is almost impossible to predict a shear strength profile in peat and attempts to measure the shear strength using normal geotechnical methods can be misleading. Typical values of shear strength from hand shear vanes would be in the range 10-60 kilopascal (kPa) although values over 100 kPa have been recorded in peat elsewhere. The higher strengths are almost certainly the influence of roots or other non-decomposed material. It is believed that the strength of peat should be quoted as a cohesion value as there are few, if any, discrete particles to give the material a significant frictional resistance. It should be noted, however, that any quotation of shear strength for peat should be treated with extreme caution.

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[6] Ingram, H.A.P., (1978), 'Soil layers in mires: function and terminology'. Journal of Soil Science, 29, 224-227.

[7] Von Post, L. and Grunland, E., (1926), 'Sodra Sveriges torvillganger 1' Sverges Geol. Unders. Avh., C335, 1-127.

[8] Hobbs, N.B., (1986), 'Mire morphology and the properties and behaviour of some British and foreign peats.' Quarterly Journal of Engineering Geology, London, 19, 7-80.

2.1.2 Peat Stability-Factors to be Considered

There is considerable observational information relating to debris and peat flows although the actual mechanisms involved in peat instability are not fully understood. The main influences on slope stability are geological, geotechnical, geomorphic, hydrological, topographic, climatic, agricultural and human influences such as drainage and construction activity. Peat is affected to a degree by changes in any of the above list and it is vital to appreciate that changes to the existing equilibrium would affect the level of slope stability during construction and operation of the Development.

Some of the contributory factors to peat instability are summarised as follows:

- The geographical limits which could be affected by potential instability are not confined to the artificial boundaries imposed by land ownership; landslip occurring above a site could affect the site and property down slope or downstream of the site for several kilometres.
- Agriculture and grazing have a substantial effect on peat areas, and this can be compounded in areas that have been managed to improve grazing. Grazing compacts the peat surface reducing the rainwater infiltration and the additional nutrients change the ecological balance of the original peat bog. Agricultural management can include surface drainage and periodic burning, both of which can leave the surface of the peat bare for a period of time resulting in temporary desiccation of the surface. Subsequent wetting of the peat and resumption of peat accumulation results in the former desiccated and possibly ash covered surface being incorporated into the body of the peat which introduces a weak discontinuity in the profile; this in turn becomes another unknown factor in the stability assessment.
- Forestry has a substantial effect on slope stability particularly in the early stages as the creation of a forest involves disruption of the natural equilibrium and drainage of the slopes and the installation of artificial drains by deep ploughing. The construction of access tracks further disrupts the drainage and concentrates groundwater flow into narrow, fast flowing erosive streams. The work by Winter *et al* [9] noted that forest tracks can act to retard or concentrate the down slope flow of water and thus aid its penetration into the slope below. Such a mechanism has been observed at a number of recent landslips that have affected the road network in Scotland.
- Natural drainage – some of the precipitation falling onto a natural upland peat bog would be absorbed into the low permeability catotelm peat. However, most of the water would run-off as sheet flow through upper, high permeability acrotelm. Thus, the water is transmitted to the lower slopes in a reasonably controlled manner through a range of interconnections that operate at different scales and speed. Failure to understand this and to disrupt the transmission process for the groundwater could result in instability.
- Artificial drainage - where agricultural drainage has been used to improve the quality of the grazing or to promote forestry it reduces the overall volume of water entering the bog and transfers this water to the edges more rapidly. This can result in ditches and streams becoming enlarged, causing increased erosion and a greater silt burden in the stream water.

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[9] Winter, M.R., Macgregor, F. and Shackman, L. (2005a), 'Scottish tracks networks landslide study' Trunk tracks: network management division, published report series. The Scottish Government.

2.2 Peat Mass Stability

The principal surface indicator of peat slide potential is cracking of the peat land surface, and it is the identification of crack patterns in the field and the attendant causes of the cracking that is fundamental to a peat stability assessment.

Sites that have exhibited natural instability in the past are likely to be more susceptible to future instability during and following construction of a renewable energy development, therefore it is important to identify such instability as part of the Peat Stability Assessment.

2.2.1 Types of Failure

The result of instability in peat is the down-slope mass movement of the material; there are a number of definitions of peat instability which are used to characterise the type of failure including:

- Bog bursts or bog flows – the emergence of a fluid form of well humified, amorphous peat from the surface of a bog, followed by the settling of the residual peat, in-situ [10].
- Peat slides – the failure of the peat at or below the peat/ substratum interface leading to translational sliding of detached blocks of surface vegetation together with the whole underlying peat stratum[10].
- Bog slide – an intermediate form of instability where failure occurs on a surface within the peat mass with rafts of surface vegetation being carried by the movement of a mass of liquid peat.

2.2.2 Bog Bursts

Accounts of bog bursts are generally associated with very wet climates or areas which have received storm rainfall events. Bog bursts can be associated with particularly wet peat landscapes; therefore, it is possible to identify broad regions of a higher susceptibility to these failures. The constraints used to identify the areas of higher susceptibility to bog burst failure are given below:

- Peat thickness greater than 2m.
- Shallow gradients, generally within the range of 2 to 5°, peat thicker than 1.5m is generally not observed on slopes steeper than 10°, also moisture content is generally reduced on steeper slopes due to drainage).
- Ground which is annually waterlogged to within the upper 1m below ground level (the groundwater level may rise above this but rarely falls below).
- Greater humification of the lower catotelm within the waterlogged ground; and lower surface tensile strength of the fibrous peat and vegetation.

The humified mass can be considered as analogous to a heavy liquid and the stability of this mass is maintained by the strength of the surface or acrotelm peat. Should the surface become weakened through erosion or desiccation or the construction of a surface drainage ditch for agricultural or forestry reasons or through turbary (peat cutting), failure is made more likely.

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[10] Dykes, A.P and Kirk, K.J., (2001), 'Initiation of a multiple peat slide on Cuilcagh Mountain, Northern Ireland.' Earth Surface Processes and Landforms, 26, 395-408.

2.2.3 Peat Slides

Peat slides tend to be translational failures with a defined shear surface at or close to the interface with the substrate.

The factors generally considered to influence susceptibility to peat slide failures are listed below:

- Peat depth up to 3m;
- Slope gradients between 4.5º and 32º
- Natural or artificial drainage cut into the surrounding peat landscape
- Greater humification of the lower catotelm within the waterlogged ground
- Lower surface tensile strength of the fibrous peat and vegetation

It is noted that some of the factors causing instability are common to both bog bursts and peat slides.

The peat – substrate interface is the primary zone of failure and is enhanced by elevated water content at this boundary and softening or weathering of the lower mineral surface. For this reason, any investigation or probing should try to distinguish the nature of the lower mineral substrate.

2.2.4 Bog Slides

A bog slide is a variation on a peat slide where part of the peat mass is subject to movement, usually on an internal layer of material, which may be more prone to movement, such as an interface between the acrotelm and catotelm layer.

2.2.5 Natural Instability

The stability of a peat mass is maintained by a complex interrelationship of many factors. Key factors include sloping rock head and proximity to a water body. Rainfall often acts as the trigger after the slope has already been conditioned to fail by natural processes.

It should also be remembered that peat bogs are growing environments and that there would come a time, on sloping ground, where the forces causing instability, the weight of the bog, can no longer be resisted by the internal strength of the peat and its interface with the underlying mineral surface. At this point, failure would occur.

The weight of the peat bog or any soils mantling steep hill slopes would be increased during periods of very heavy rain and it is common to see landslips occurring following extreme rain events. This may be a concern for future developments where one of the predicted effects of global warming will be a greater frequency of extreme weather, intense storms being one element.

3.0 Desk Based Review

3.1 Site Description

The Proposed Development is located approximately 27km south-east of Inverness, and approximately 5.5km south of the village of Tomatin. The Proposed Development is predominately managed upland grouse moorland with agricultural fields and mixed woodland in lower altitude areas. Clune Burn and Allt Lathach traverse the Proposed Development along with other smaller tributaries running into the River Findhorn that lies to the north-west.

The Proposed Development inclines generally in a north-east to south-west direction, reaching the highest point, 750m, at Carn Dubh'Ic an Deoir. The northern edge is bounded by the River Findhorn and the eastern boundary by the A9. The Proposed Development can be approximately divided by four main watercourses that flow north into the River Findhorn: Allt Phris, Clune Burn, Allt Lathach, and Wester Strathnoon Burn.

The Proposed Development is mainly used as a grouse moor and managed by grazing livestock such as sheep. The Proposed Development also consists of small patches of grassland along the northern boundary used by grazing livestock, a block of conifer plantation in the north-east, and an area of ancient deciduous woodland on the banks of the Allt Phris. The proposed access track will be situated on the north-eastern boundary of the Proposed Development, connecting to the A9 just north of Slochd summit, using an existing minor road (U2586).

3.2 Geology and Soils

3.2.1 Artificial Ground

Based on the information available from the BGS Geoindex[11], no made ground deposits are noted across the Proposed Development.

3.2.2 Superficial Geology

Based on the available BGS online data[11] the superficial geology in the north-western extent of the Proposed Development comprises glacial till and glaciofluvial deposits. There are minor deposits of peat and blanket head deposits present. The central area of the Proposed Development comprises glacial till and peat deposits whilst the southern extent is underlain by predominantly peat and glacial till. There are areas with no superficial deposits mapped and these relate to bedrock at surface and are typically locate do the hilltops. The BGS records localised alluvium deposits within areas of small surface waters with more extensive alluvium mapped around larger rivers at the River Findhorn and River Dulnain.

Figure 9.1.3 shows the superficial geology BGS mapping and the Proposed Development.

3.2.3 Bedrock Geology

Based on the available BGS online data[11] the majority of the Proposed Development is underlain by gneissose semipelites and psammites of the Dalradian Supergroup, Beinn Bhreac Psammite Formation, Glen Banchor Subgroup and Slochd Psammite Formation. The centre of the Proposed Development, near An Socach comprises of the Loch Laggan Psammite Formation. The area south of Carn Ruighe Shamraich contains a minor unit of the Ardair Semipelite Formation.

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[11] BGS Online Viewer, available at [https://mapapps2.bgs.ac.uk/geoindex/home.html?_ga=2.133433804.376188765.1646739904-1030004651.1646739904]

Several igneous intrusions of the Scottish Highland Ordovician Minor Intrusion Suite composed of pegmatite and felsites of the North Britain Devonian Calc-alkaline Dyke Suite are noted across the Proposed Development.

A minor plutonic intrusion is mapped at carn Coire na Caorach on the western flank of the hill.

A number of inferred faults are present north-west of the Proposed Development trending north-east to south-west. There are no mapped faults within the Proposed Development.

Figure 9.1.4 shows the bedrock geology BGS mapping and the Proposed Development.

3.3 Peatland Classification

The Carbon and Peatland Map 2016[12] indicates that much of the southern and central extents of the Proposed Development are located within Class 1 peatland which are considered nationally important carbon-rich soils, deep peat and priority peatland habitats and areas likely to be of high conservation value. Within the north-western extent of Proposed Development there are localised Class 1 deposits close to Carn a' Gharbh Choire.

Class 5 peatland covers much of the area of the Proposed Development with discrete area of Class 3 (habitats which may contain carbon rich soils and deep peat but are not considered to be of high conservation value) present in the northern extent of the Proposed Development near Carn na Loinne.

3.4 Ground Stability Hazards

BGS Online data[11] records indicate that there is no risk regarding the mass movement or instability of materials.

3.5 Mining and Quarrying

Information from The Coal Authority Online Viewer[13] indicates that the Proposed Development is not within a coal mining reporting area.

BGS Online data[11] indicate there are two historical pits, named Dalnabeist and Carn a'Gharb-choire located in the north of the Proposed Development, both have ceased status.

3.6 Hydrogeology

Information from Scotland's Environment Online Map Viewer[14] indicates that the Proposed Development is underlain by the Strathnairn, Speyside and Cairngorms waterbody (ID: 150709), and is classified as having a 'good' overall status, as part of the most recent information available from SEPA (2022).

The aquifer underlying the Proposed Development area is part of the Moine Supergroup, Class 2C and a low productivity aquifer. This suggest that small volumes of groundwater are present in near surface weathered zones and secondary fractures, and flow within the aquifer is predominantly through fractures and other discontinuities

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[12] NatureScot, Carbon and Peatland Map 2016, Available online at: https://map.environment.gov.scot/soil_maps/

[13] The Coal Authority, The Coal Authority Map Viewer, Available online at: https://datamine-cauk.hub.arcgis.com/

[14] Scotland's Environment, Scotland's Environment Map, Available online at: https://map.environment.gov.scot/sewebmap/

3.7 Hydrology

Information from SEPA's Water Classification Hub[15] indicates that there are several rivers on and close to the Proposed Development.

The River Dulnain - Allt an Aonaich (ID: 23110), is located within the north-east corner of the Proposed Development and is classified as 'good' in this area.

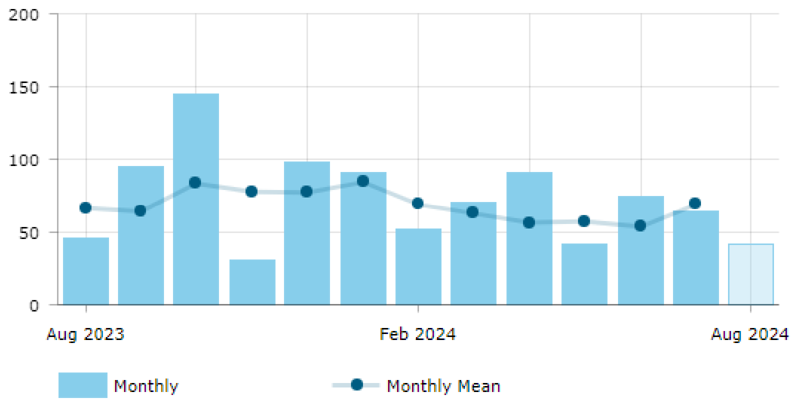
River Dulnain - upper catchment is a river (ID: 23107), is a river located approximately 1km south of the Site, flowing north to south. The main stem is approximately 24.5km in length.

The River Findhorn (ID:23012) is a major river located approximately 500m north of the Site, flowing south to north. The main tributary of the river is approximately 8.8km in length and outwith the Proposed Development area.

3.8 Rainfall

SEPA have provided precipitation data[16] for Sluggan rainfall gauge (station number 234314) which is located approximately 5km south-east of the Proposed Development.

Image 1: Monthly Rainfall totals in mm from Sluggan Station



3.9 Groundwater Dependent Terrestrial Ecosystems (GWDTE)

As detailed in EIA Volume 2, Chapter 9: Geology, Hydrology and Hydrogeology, no GWDTE's with the potential to be affected by the Proposed Development have been identified to be groundwater dependent and therefore, not considered to be a potential receptor for peat instability.

3.10 Private Water Supplies and Licenced Sites

A review of The Highland Council data and previous assessments within the area of the Proposed Development indicates that there are two private water supplies (PWS) which are at potential risk from the Development. However, they are not deemed to be a receptor of any potential peat instability.

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[15] SEPA, Water Classification Hub, available online at: https://www.sepa.org.uk/data-visualisation/water-classification-hub/

[16] SEPA, Rainfall Data for Scotland, available online at: https://www2.sepa.org.uk/rainfall

3.11 Environmental Designations

Information from Scotland's Environment Online Map Viewer[17] indicates that the Proposed Development encompasses part of the Kinveachy Forest SSSI in the south. The Slochd Geological Conservation Review site is located in the north-east corner of the Proposed Development. There are no Special Areas of Conservation (SAC) sites within the Proposed Development however, the Kinveachy Forest SAC is located immediately adjacent to the Site along the southern boundary.

3.12 Geomorphology

The Proposed Development is generally characterised by upland mountainous moorland that inclines in a north-east to south-west direction. The Proposed Development features steep hillslopes and deep valleys with topographic lows and breaks in slope. Areas in the north-east of the Proposed Development are generally topographically lower than in the central and southern areas. The Proposed Development also contains wide ridges and incised gulleys, with flatter expanses existing in the slope breaks and topographic lows between the hillslopes.

Detailed geomorphology mapping is detailed on **Figure 9.1.5**. Typical conditions observed throughout the Proposed Development are detailed below in the following photographs.

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[17] Scotland's Environment, Scotland's Environment Map, Available online at: https://map.environment.gov.scot/sewebmap/

Plate 1: Gulley and steep slopes at Carn Ruighe Shamhraich, looking west from Carn Coire na Cluanaich . National Grid Reference (NGR): NH 79564 22434.

3.12.1 Blanket Bog

Peat deposits are common throughout the Proposed Development, with areas of deep peat noted across the majority of the Proposed Development. There is an area of extensive blanket bog in west of the Proposed Development near Carn Bad an Daimh, peat depths of over 2m were recorded. Blanket bog was also surveyed north of T20, with over 2m of peat being recorded. There are localised hollows of blanket bog across the Proposed Development which occur at breaks of slopes. The borrow pit search area located directly east of T18 had small peat hollows present on the southern slopes. An area of localised peat bog is situated at the south-west slope of Carn a' Gharbh-choire within the break in slope before topography begins to steepen towards Carn na Glaic Fhluich.

No areas of instability were noted in relation to the peat deposits recorded across the Proposed Development.

Plate 2: Extensive blanket peat bog located east of Carn Bad an Daimh looking northeast. NGR: NH 76881 21680.

3.12.2 Peat Erosional Features

There are extensive areas of peat hagging across the Proposed Development. Peat haggs were seen on the flanks of Carn Core na Cluanaich (north-east of T12) with exposed haggs up to 2.5m in height. The west of the Proposed Development also has extensive erosional features with largescale hagging recorded on the east slopes of Carn Bad an Daimh near T26 with haggs of 1.8m-2m measured. Peat haggs were observed at T2 related to active erosion on the north-west of Carn Mheadhoin. T15 also had extensive peat haggs with peat depths of 1.2m measured.

Based on Site observations, hagging across the Proposed Development is likely to be exacerbated by wind erosion due to the topographically exposed nature of this area and higher elevations. In addition, there is evidence of hydrologically influenced gully erosion due to localised networks of drainage across the peatland.

No areas of instability were noted in relation to any erosional features across the Proposed Development.

Plate 3: Peat haggs near T15 looking south-west. NGR: NH 78311 20942.

3.12.3 Artificial Drainage and Cuttings

The Proposed Development features extensive artificial drainage that generally trend north to south. These drainage ditches were recorded up to 1m deep and 0.8m wide. In some areas drainage was recorded as trending east to west, particularly at the south of T15, this was related to slope direction. Peat cuttings were also noted during surveys, predominantly south-west of Carn a’ Gharbh-choire.

No areas of instability were noted in relation to artificial drainage and cuttings across the Proposed Development.

Plate 4: Drainage ditch trending north-west to south-east at T13. NGR: NH 79564 22434

Plate 5: Peat cuttings south-west of Carn a' Gharbh-choire. NGR: NH 81910 25372.

3.12.4 Forestry

Forestry is not common across the Proposed Development. There are areas of localised forestry plantation and associated drainage furrows at Carn a' Phris which trend either north to south or east to west when reviewed on aerial imagery. This trend was also noted during survey visits. Ancient deciduous woodland is situated east of Carn Lodge, on the banks of the Allt Phris.

No areas of instability were noted in relation to forestry across the Proposed Development.

Plate 6: Deciduous forestry east of Clune Lodge, look north-west. NGR: NH 81408 2557.

3.12.5 Bedrock

From review of aerial photography, bedrock outcrops are abundant across the Proposed Development. This was confirmed during Site walkovers where bedrock outcrops were frequently encountered. Bedrock was often seen on the tops of ridges and flatter tops, mostly bedrock was observed as weathered regolith or at near surface.

No areas of instability were noted in relation to bedrock exposures across the Proposed Development.

Plate 7: Bedrock south of Carn a' Phris, Mica Schist. NGR: NH 81408 25571.

3.12.6 Extension/Compression Features

It was not possible to identify evidence of any significant historic peat failures or slides at the Proposed Development from the aerial photographs and this was confirmed during Site visits with no evidence of any extension or compression features identified in the peat during Site visits.

4.0 Site Work

4.1 Peat Depth Survey

Peat surveys were carried out in accordance with best practice guidance for developments on peatland[18,19]. Phase 1 peat probing, undertaken by Atmos Consulting, was conducted on a 100m grid to allow for initial assessment of the Proposed Development which was used in preliminary Site layout designs.

Where surveys were undertaken by SLR, the thickness of the peat was assessed using a graduated peat probe, approximately 6mm diameter and capable of probing depths of up to 10m. This was pushed vertically into the peat to refusal and the depth recorded, together with a unique location number and the co-ordinates from a handheld Global Positioning System instrument (GPS). The accuracy of the GPS was quoted as ±2m, which was considered sufficiently accurate for this survey. All data was uploaded into a GIS database for incorporation into various drawings and analysis assessments.

Where the peat probing met refusal on a hard substrate, the 'feel' of the refusal can provide an insight into the nature of the substrate. The following criteria were used to assess material:

- Solid and abrupt refusal – rock;
- Solid but less abrupt refusal with grinding or crunching sound – sand or gravel or weathered rock;
- Rapid and firm refusal – clay; or
- Gradual refusal – dense peat or soft clay.

The relative stiffness of the peat was also assessed from the resistance to penetration of the probe and to the effort required to extract the probes (retrieval of the probe was often impossible for one person). In all instances refusal was met on obstructions allowing identification of subsurface geology.

4.2 Peat Depth

Peat is generally defined as a soil with a surface organic layer in excess of 0.5m[18]. Where the probing recorded less than 0.5m thick, it is considered to be a peaty soil (or organo-mineral soil). Soils with a peaty organic horizon over mineral soil are often referred to as 'peaty soils'. These organo-mineral soils are extensive across the UK uplands, but do not meet recognised definitions of peat as they are either shallower than true peat or have a lower carbon density.

The peat was found to vary across the Proposed Development in terms of thickness and coverage. Deeper peat was generally encountered in flatter, lower gradient areas of the Proposed Development.

The maximum depth of recorded peat was 4.7 metres below ground level (mbgl), recorded at three locations; north-east of T12, south-west of T10 and north of T25. The average thickness of peat recorded across the Proposed Development was 0.5m.

A total of 10,641 peat probes were undertaken across all survey phases, with the results summarised in **Table A** and detailed within the peat depth interpolation figures provided in **Figure 9.1.6** and **Figure 9.1.7**. The interpolation was undertaken using the Inverse Distance Weighting (IDW) methodology. All probing data is provided in **Annex A**.

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[18] Scottish Renewables & SEPA (2012) 'Developments on Peatland Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and the Minimisation of Waste'.

[19] Scottish Natural Heritage (SNH), SEPA, Scottish Government & James Hutton Institute. (2014)' Peat Survey Guidance; Developments on Peatland: Site Surveys'.

Table A: Peat Probing Results

Peat Thickness (m)	No. of Probes	Percentage (of total probes undertaken on-site)
0 (no peat or soil)	203	1.9
0.01 – 0.49 (peaty soil)	6290	59.1
0.50 – 0.99	2512	23.6
1.00 – 1.49	833	7.8
1.50 – 1.99	536	5.0
2.00 – 2.49	176	1.7
2.50 – 2.99	47	0.4
3.00 – 3.49	25	0.2
3.50 – 3.99	3	0.0
> 4.0	16	0.2

4.3 Peat Condition

Peat is described using BS5930[20] and the Von Post classification[21]. Six peat cores and samples were collected by SLR during Phase 2, using a peat auger and used to inform interpretations of the underlying peat condition and underlying substrate. Peat samples were undertaken to depths of between 0.6 and 1.9 mbgl.

The peat was generally described as brown to dark brown, fibrous to pseudo-fibrous peat. The majority of the peat encountered throughout the Proposed Development would be classified as between H3 and H5 in the von Post classification, showing insignificant to moderate decomposition. Amorphous peat was not encountered during the peat coring. Heather was recorded to be the predominant vegetation cover on the Proposed Development with evidence of extensive artificial drainage and localised areas of actively eroding peat.

The area of peatland near Carn Coire na Cluanich was seen to be actively eroding with extensive peat haggs and gulley erosion. This area was observed to be typically dry being observed on the base of the peat haggs, relating to the extensive artificial drainage (see Plate 4 and 9). Sphagnum flushes were most prevalent within drainage ditches and peat haggs where areas of localised saturation have been formed.

As with the land use of sheep grazing across the Proposed Development,evidence of rotational grazing and prescribed burning were seen during surveys (see Plate 8). With most of this being seen in the north of the Proposed Development near Carn Ruighe Shamhraich and Carn Phris Mhoir.

Ground conditions underfoot were typically dry and firm during the surveys within the main development areas. The widespread drainage is likely to have hydrologically comprised the peat by lowering water levels and leading to consolidation of the peat which was evidenced by the typically firm nature of the peatland underfoot within the main development areas.

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[20] BS 5930:2015+A1:2020, Code of practice for ground investigations

[21] Von Post, L. and Grunland, E., (1926), 'Sodra Sveriges torvillganger 1' Sverges Geol. Unders. Avh., C335, 1-127.

Plate 8: Prescribed burning of heather at T11, looking north from the south-west flanks of Carn Phris Mhoir. NGR: NH 80293 21670.

Plate 9: Actively eroding peat haggs, looking south. NGR: NH 80125 22572.

The majority of the Proposed Development peatland condition is drained and modified.

Peat core logs and photographs are presented within **Annex B**.

4.4 Substrate

Where possible an assessment of the substrate was made. The assessment was based on a review of the aerial and geological mapping as well as evidence from Site walkovers. It is recommended that during detailed design phase the substrate should be verified by ground investigation data. The substrate falls into either of the two following categories:

- granular (sand and/or gravel/weathered rock), of glacial origin and occasionally interbedded with silty sands; and
- rock, no rock samples were recovered from the probe locations.

5.0 Hazard and Risk Assessment

5.1 Introduction

The Scottish Government Guidance[1] provides an overview of the principles of hazard and risk with respect to peat landslides. The guidance is noted as illustrative only and the developers can present their own methodology providing, it is clearly explained and incorporates consideration of the likelihood of instability and the consequences should it occur. The following sections detail the preferred methodology used within this assessment.

A 'Hazard Ranking' system has been applied based on the analysis of risk of peat slide as outlined in the Scottish Government Guidance[1]. This is applied on the principle:

Hazard Ranking = Hazard x Exposure

This philosophy can be applied to the assessment carried out so far in the following approach:

Hazard Ranking = Risk Rating x Impact Rating

5.2 Methodology

The determination of Risk Rating and Impact Rating values is based on a number of variables which impact the likelihood of a peat slide and the relative importance of these variables specific to the Proposed Development.

Similarly, the consequences or Exposure to receptors is dependent on variables including the particular scale of a peat slide, the distance it will travel, and the sensitivity of the receptor.

In the absence of a predefined system, the approach to determining and categorising Risk Rating and Impact Rating is determined on a site-by-site basis. The particular system adopted for the PLHRA is outlined in the following sections.

5.3 Slope Stability

The stability of peat is a complex subject and there are numerous inter-relationships that affect the stability.

A quantitative assessment requires a numerical input and such an analysis cannot account for the unquantifiable input required for a comprehensive peat stability assessment. For this reason, a purely quantitative assessment should only be considered as a guide and a qualitative assessment of stability should be used to inform the final recommendations.

The characteristics of the peat failure phenomena have been incorporated in a stability risk assessment to evaluate the risk of instability occurring within the peat areas. The main factors controlling the stability of the peat mass are the surface gradients, the depth and condition of the peat at each location and the type of substrate.

The natural moisture content and undrained shear strength of the peat are important; however, it is generally accepted that where present, the peat would be saturated and have a very low strength. It is believed to be unrealistic to rely on specific values of shear strength to maintain stability when back analysis of failed slopes indicates that there is often a significant discrepancy between measured strength in peat and stability. Shear strength has been assumed to be constant and worst case, throughout this assessment. It has also been assumed, as a worst case, that the groundwater level is coincident with the ground surface.

5.4 Risk Rating

The potential for a peat slide to occur during the construction of the Proposed Development depends on several factors, the importance of which can vary from site to site. The factors requiring considerations would typically include:

- Peat depth;
- Slope gradient;
- Substrate material; and
- Evidence of instability or potential instability;

Of these, peat depth and slope gradient are considered to be principal factors. Without a sufficient peat depth and a prevailing slope, peat slide hazard would be negligible.

The rating system outlined below differs slightly from that proposed in the Scottish Government Guidance[1] as the system adopted here incorporates three inputs compared to two in the guidance, with the potential impact of substrate added in this section.

The probability of a peat landslide 'Risk Rating' (score) was derived by multiplying the coefficients for the four key factors (with historic instability as 1) together to produce a risk rating which is a measure of the likelihood of peat instability, and this enables potential areas of concern to be highlighted. For the assessment, the following rating system was applied as shown in **Table B**.

Table B: Probability of Peat Landslide

Risk Rating Coefficient	Potential Stability Risk (Pre-Mitigation)	Action
<5	Negligible	No mitigation action required.
5 - <16	Low	As for negligible condition plus development of a site-specific construction and management plan for peat areas.
16 - <31	Medium	As for Low condition plus may require mitigation to improve site conditions.
31-50	High	Unacceptable level of risk, the area should be avoided. If unavoidable, detailed investigation and quantitative assessment required to determine stability and sensitivity to minor changes in strength and groundwater regime combined with long term monitoring.
>51	Very High	Unacceptable level of risk, the area should be avoided.

5.4.1 Peat Depth

Table C shows the peat depth ranges and their related peat depth coefficients. The ground conditions were assessed by using peat depths recorded during peat probing. Thin peat was classed as being 0.5 to 1.5m thick, with deposits in excess of this being classed as thick. The thickness ranges used are intended to reflect the risk of instability associated with both peat slides (in thin peat) and bog slides. Where the probing recorded peat less than 0.5m thick, this has been considered to be an organic soil rather than peat and are outside the scope of this assessment.

In addition to peat thickness, the presence of existing landslip debris or indicators of meta-stable conditions such as tension cracks or slumping in the peat suggest the material is likely to become even less stable should the existing ground conditions change. Where evidence of historical slips, collapses, creep or flows is seen, a separate coefficient has been applied.

Table C: Coefficients for Peat Depth

Peat Depth Range	Description	Peat Depth Coefficients
(<0.5 m)	Peaty/organic soil	0
(0.5 – 1.5 m)	Thin Peat	2
(>1.5 m)	Thick Peat	3*
-	Slips /collapses / creep / flows	8

***Note that thicker peat generally occurs in areas of shallow gradients and records indicate that thick peat does not generally occur on steeper gradients.**

5.4.2 Slope Gradients

Table D gives the coefficients applied to the categorised slope angles. The slope gradients were assessed by reference to the mapping and particularly the DTM which was used to generate a slope map (**Figure 9.1.8**), from which the gradient at each probe location could be determined and input into the risk rating spread sheet (**Annex A**). The gradient quoted at each location was based on the average gradient over a 5m grid.

Coefficients for slope gradient have been assigned to ensure the potential for both peat slides (gradients of 4-15°) and bog slides (gradients of 2-10°) are addressed. By simple inspection it is clear that steeper slopes pose a greater risk of instability than shallow gradients. Therefore, a graduated gradient scale from 0° to >12° (the practical maximum gradient on which peat is commonly observed) has been applied.

Table D: Coefficients for Slope Gradients

Slope Angle (°)	Slope Angle Coefficients
Slope <2°	1
2°≤ Slope <4°	2
4°≤ Slope <8°	4
8°≤ Slope <12°	6
>12° Slope	8

5.4.3 Substrate

Table E shows the substrate type and their related substate coefficient. As noted above, most failures in thin peat layers occur at the interface with the underlying substrate; the nature of the substrate has an influence on the probable level of stability.

Peat failures often occur within glacial till deposits in which an iron pan is observed in the upper few centimetres (Dykes and Warburton, 2007)[22]. They have also been observed over glacial till without and obvious iron pan, or over impermeable bedrock. They are rarely cited over permeable bedrock as the formation of peat deposits is deemed to be less likely.

Where sand and/or gravel (derived from glacial till) form the substrate, the effective strength of the interface can be considered to be good with comparatively high friction values. Under

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[22] Dykes A and Warburton J (2007) Mass movements in peat: A formal classification scheme. Geomorphology 86, pp. 73–93

these conditions, failure is likely to occur in a zone within the peat, just above the interface. Further factors are necessary to cause a failure of this nature (increased pore pressures within the peat) and occurrence of such events is rare.

Where clay forms the interface, there is likely to be a significant zone of softening in the clay (due to saturation at low normal stresses, poor or non-existent vertical drainage and the effect of organic acids), resulting in either very low undrained shear strength or low effective shear strength parameters. The result is that potential shearing could occur either in the peat, on the interface or in the clay; all three possibilities have been documented in the past.

A rock substrate provides a high strength stratum, however, the rock surface can be smooth, and, depending on the dip orientation of the strata, it can provide a very weak interface. For these reasons, at this stage, a rock interface has been given the same risk rating as clay.

Table E: Coefficients for Substrate

Substrate Conditions	Substrate Coefficients
Granular	1
Rock	2
Cohesive	3
Not proven	3
Slip material (Existing materials)	5

Probing across the Proposed Development indicated primarily granular and bedrock substrates using the refusal method. This was confirmed by coring at selected locations across the Proposed Development.

5.4.4 Results

The table of results, included in **Annex A,** shows that 10,641 probe locations were identified within the extent of the Digital Terrain Model, peat (>0.5 m) was present at 4,148 locations. The stability risk rating identified the following:

- No peat was recorded at 203 locations (2%), hence no risk;
- Negligible risk at 6,987 (66%) probe locations;
- Low risk at 2,961 (28%) locations;
- Medium risk at 490 (4%) locations; and
- High risk at 0 (0%) locations.

Figure 9.1.9 presents the interpreted risk of peat instability based on the multiplication of the risk coefficients discussed above in **Table C** to **Table E**.

5.5 Impact Rating

An assessment of the receptors ‘Impact Rating’ of the medium risk locations has been undertaken. It should be noted that the impact assessment is primarily concerned with impacts that affect the environment, ecology, public or infrastructure associated with the development, both on-site and potentially off-site. This assessment does not consider the detailed ecological impact of construction induced peat instability; however, the majority of the sensitive on-site receptors are the watercourses and thus the inferred ecological and environmental issues are addressed. The proposed mitigation measures in Section 6.0 would limit the potential for any slope failures into water courses and drainage features hence limit such impacts. The effect a slope failure may have on the construction site and infrastructure can be easily identified.

However, the effect of an instability event on features impacted by an event not associated with the Proposed Development is harder to predict. In order to address this effect, it is not considered appropriate to assess the effect at every potential receptor location close to the Proposed Development; but rather to assess the effect a particular infrastructure feature (track, wind turbine, substation, etc.) would have on the structures or features surrounding it. By adopting such an approach, the assessment of infrastructure features where a risk ranking of ‘negligible’ or ‘low’ (assessed in the stability risk assessments described above) is discounted from further assessment.

The impact rating coefficient (score) is derived by multiplying the receptor ranking coefficient (score) by the distance coefficient (score) and the elevation coefficient (score) for each impact receptor associated with a particular infrastructure feature. The ranking process by attributing the different weighting systems to each factor is detailed in the following sub-sections.

5.5.1 Receptor Ranking

Receptors are generally nearby structures or features that may be affected by peat movements caused during or following construction. Generally, only receptors immediately down gradient of the infrastructure feature could be affected by peat instability therefore the first phase of feature ranking requires topographic ridges and valleys to be identified across the Proposed Development and surrounding area. From this, receptors at risk from particular infrastructure features can be identified. However, should instability occur on a steep slope, there is the risk of the back scarp of the instability migrating up-slope, there-by affecting areas previously considered not to be at risk.

The main receptors located within the Proposed Development and surrounding area which could potentially be affected in the event of a peat slide; were primarily watercourses and associated tributaries, existing tracks and paths and the proposed wind farm infrastructure.

Following identification of receptors at risk, these are ranked according to their size and sensitivity. **Table F** presents the coefficients placed on particular receptor types.

Table F: Coefficients for Receptor Ranking

Nature of Feature	Feature Coefficient
Non-critical Infrastructure (minor/private roads, tracks)	1
Wind Farm Infrastructure (turbines, hardstandings, tracks, borrow pits, compounds, substation, etc.,)	3
Sensitive Hydrological Feature (watercourses, GWDTE, PWS, etc.,)	3
Sub-Community (settlement 1-10 residents)	6
Community (settlement of >10 residents)	8

5.5.2 Receptor Proximity

The proximity of an impact receptor is also critical in assessing the likely level of disruption it may suffer following an instability event. Based on this, two further coefficients – distance from infrastructure feature and relative elevation differences between the infrastructure feature and impact receptor - are applied in deriving an impact ranking. **Table G** and **Table H** present the coefficients derived for distance and elevation of impact receptors.

Table G: Coefficient for Receptor Proximity

Distance from Coefficient Feature	Distance Coefficient
> 1 km	1

Distance from Coefficient Feature	Distance Coefficient
100 m – <1 km	2
10 – <100 m	3
0 – <10 m	4

Table H: Coefficient for Impact Feature Elevation

Relative Elevation of Feature	Elevation Coefficient
0 -<10 m	1
10 – <50 m	2
50 – <100 m	3
> 100 m	4

Based on distance to impact receptors, in this instance we have identified watercourses (which are the most sensitive receptor near the Proposed Development). The other receptors have been discounted, either they are not present or distance to receptor mitigates risk. Watercourses are the principal receptor as they are at risk of not only direct impact from a peat slide but potentially the water course creates a pathway to impact other receptors indirectly, either ecological or potential water users downstream. Based on **Table F** the watercourses would have an impact receptor coefficient (score) of 3 and then considering the distance to the receptor and the relative elevation differences on-site of receptors, a potential impact can be derived.

5.6 Hazard Ranking

In order to achieve a meaningful and manageable result from the hazard ranking, the results of the Risk Rating and Impact Rating have been normalised to a standard numerical scale (below).

Table I: Rating Normalisation

Risk Rating		Impact Rating	
Current Scale	Normalised Scale	Current Scale	Normalised Scale
Negligible <5	1	Very Low <10	1
Low 5 - <16	2	Low 11 - 20	2
Medium 16 – <31	3	High 21 - 30	3
High 31 - 50	4	Very High 31-50	4
Very High >51	5	Extremely High >51	5

The method of assessing probability of landslide, adverse consequence and hazard developed by SLR Consulting incorporates additional critical elements such as the substrate interface and coefficients for the receptor position, distance and elevation and as such is considered to be more rigorous than the assessment scheme proposed by the Scottish Government[1]. The Hazard Ranking scale does equate to the Scottish Government[1] scale, with rankings divided over four zones.

A simple multiplication of these coefficients would result in potentially large and unwieldy risk and impact rating numbers. SLR has therefore opted to normalise these values to bring them in line with the values used in the Scottish Government Guidance[1], as illustrated in Table I.

Table J: Hazard Ranking

Hazard Ranking	Hazard Ranking Zone	Action
1-4	Insignificant	No mitigation action required although slide management and monitoring shall be employed. Slide management shall include the development of a site specific construction plan for peat areas.
5 - 10	Significant	As for Insignificant condition plus further investigation to refine the assessment combined with detailed quantitative risk assessment to determine appropriate mitigation through relocation or re-design.
11 - 16	Substantial	Consideration of avoiding project development in these areas should be made unless hazard mitigation can be put in place without significant environmental effect.
17-25	Serious	Unacceptable level of hazard; development within the area should be avoided.

The stability risk assessment has demonstrated that the majority of the Proposed Development lies within an area of negligible to low risk (96% of probe locations) with regards to stability based on **Figure 9.1.9** and therefore discounted from further slide risk assessment and mitigation as detailed below.

4% of probe locations identified a medium risk of peat instability across the Proposed Development. Following review, the majority of these locations are not considered to have either a potential impact on the development infrastructure, due to locality, either well away from influencing infrastructure, in a down gradient position or have no impact on the local watercourses (receptors). Therefore 15 medium risk sites have been identified and are discussed in the following section.

The stability risk assessment results presented in Table K shows the calculated hazard ranking associated with every location where there is a stability risk of medium or above, at or close to infrastructure. The particular mitigation measures to reduce the risk of instability occurring are dependent upon location and the type of proposed structure. Proposed mitigation measures and actions already undertaken to reduce the risk of peat instability occurring are also identified in Table K, together with the associated, revised hazard ranking. A more detailed discussion of the possible mitigation measures is presented in Section 6.0.

6.0 Slide Risk and Mitigation

6.1 Overview

A number of mitigation measure can be implemented to further reduce the risk levels identified across the Proposed Development. These range from infrastructure specific measures to general good practice that should be applied across the Proposed Development to increase awareness of peat instability and enable early identification of potential displacement and opportunities for mitigation.

Risks may be mitigated by:

- Undertaking site specific stability analysis using better quality geotechnical data, final design loads for infrastructure and detailed ground models in areas of specific concern.
- Precautionary construction measures – including use of monitoring, good practice and a geotechnical risk register relevant to all locations.

Mitigation measures are provided below specific to each area of “Medium” risk. These mitigation measures will also help further reduce “Low” and “Negligible” risks to potential receptors. Sections 6.3 to 6.4 provide information on good practice pre-construction, during construction and post-construction (i.e. during operation).

6.2 Proposed Mitigation

As noted in **Figure 9.1.9**, where the risk assessment has identified a negligible or low risk of peat instability, no specific mitigation measures are necessary. However, in order to ensure best practice is employed, there would be a need for careful monitoring and the construction management must include careful design of both the permanent and temporary works appropriate for peat soils; these are discussed further in Section 6.3 to 6.4.

The areas of the infrastructure that were rated as medium risk were subjected to a hazard assessment; a number of areas were discounted as they do not fall within influencing distance of any of the key proposed Site infrastructure. The procedure adopted was to review the peat slide risk data and identify those areas with a medium risk or greater, that were in close proximity or influencing distance of any of the proposed infrastructure or watercourses. Those risk areas where there is no development would not affect the natural stability of the peat.

Table K lists the 15 locations that have been identified to have a “Medium” risk of peat instability on the Proposed Development infrastructure. A variety of mitigation measures are recommended to reduce the risk of peat instability. Analysis of each location has shown that all can be mitigated to a Hazard Ranking of “Insignificant”.

Table K: Risk Register

Risk No.	Risk Rating	Impact Rating	Hazard Ranking	Infrastructure	Key Receptor	Mitigation	Revised Hazard Ranking
1	Medium	Very Low	Insignificant	Borrow pit	Upgraded track	Excavation of peat prior to development of borrow pit would reduce and mitigate risk of peat landslide to the north. Good construction practices, as detailed in section 6.3 and 6.4, should be followed to mitigate against any instability.	Insignificant
2	Medium	Low	Significant	Borrow pit	Allt Lathach (watercourse)	Excavation of peat prior to development of borrow pit would reduce and mitigate risk of peat landslide to the north. Good construction practices, as detailed in section 6.3 and 6.4, should be followed to mitigate against any instability.	Insignificant
3	Medium	Low	Significant	Borrow pit	Allt Lathach (watercourse)	Excavation of peat prior to development of borrow pit would reduce and mitigate risk of peat landslide to the north-east. Good construction practices, as detailed in section 6.3 and 6.4, should be followed to mitigate against any instability.	Insignificant
4	Medium	Low	Significant	Upgraded Track	Allt Lathach (watercourse)	Excavation of peat prior to construction would reduce and mitigate risk of peat landslide to the north. Suitable shoring of excavations would assist in mitigating risk during construction. Benching of slopes along tracks would also mitigate against risk. Maintaining drainage pathways will reduce risk of peat slide. Good construction practices, as detailed in section 6.3 and 6.4, should be followed to mitigate against any instability.	Insignificant
5	Medium	Low	Significant	Borrow pit	Unnamed watercourse	Excavation of peat prior to development of borrow pit would reduce and mitigate risk of peat landslide to the north-west. Good construction practices, as detailed in section 6.3 and 6.4, should be followed to mitigate against any instability.	Insignificant
6	Medium	Low	Significant	Excavated Track	Unnamed watercourse	Excavation of peat prior to construction would reduce and mitigate risk of peat landslide to the south. Suitable shoring of excavations would assist in mitigating risk during construction. Benching of slopes along tracks	Insignificant

Risk No.	Risk Rating	Impact Rating	Hazard Ranking	Infrastructure	Key Receptor	Mitigation	Revised Hazard Ranking
						would also mitigate against risk. Maintaining drainage pathways will reduce risk of peat slide. Good construction practices, as detailed in section 6.3 and 6.4, should be followed to mitigate against any instability.	
7	Medium	Low	Significant	Floating Track	Unnamed watercourse	Floating track proposed along this area of access track, removing requirement to excavate and reducing risk of potential instability. Drainage pathways should be maintained during construction of track. Good construction practices, as detailed in section 6.3 and 6.4, should be followed to mitigate against any instability.	Insignificant
8	Medium	Low	Significant	Excavated Track	Upgraded Track	Excavation of peat prior to construction would reduce and mitigate risk of peat landslide to the north. Suitable shoring of excavations would assist in mitigating risk during construction. Benching of slopes along tracks would also mitigate against risk. Maintaining drainage pathways will reduce risk of peat slide. Good construction practices, as detailed in section 6.3 and 6.4, should be followed to mitigate against any instability.	Insignificant
9	Medium	Low	Significant	Excavated Track	Unnamed watercourse	Excavation of peat prior to construction would reduce and mitigate risk of peat landslide to the north-east. Suitable shoring of excavations would assist in mitigating risk during construction. Benching of slopes along tracks would also mitigate against risk. Maintaining drainage pathways will reduce risk of peat slide. Good construction practices, as detailed in section 6.3 and 6.4, should be followed to mitigate against any instability.	Insignificant
10	Medium	Very Low	Insignificant	Excavated Track & Hardstanding	Existing track (estate track)	Excavation of peat prior to construction would reduce and mitigate risk of peat landslide to the north-east. Suitable shoring of excavations would assist in mitigating risk during construction. Benching of slopes along tracks would also mitigate against risk. Maintaining drainage pathways will reduce risk of peat slide.	Insignificant

Risk No.	Risk Rating	Impact Rating	Hazard Ranking	Infrastructure	Key Receptor	Mitigation	Revised Hazard Ranking
						Good construction practices, as detailed in section 6.3 and 6.4, should be followed to mitigate against any instability.	
11	Medium	Very Low	Insignificant	Floating Track	Unnamed watercourse	Floating track proposed along this area of access track, removing requirement to excavate and reducing risk of potential instability. Drainage pathways should be maintained during construction of track. Good construction practices, as detailed in section 6.3 and 6.4, should be followed to mitigate against any instability.	Insignificant
12	Medium	Low	Significant	Excavated Track & T8	Unnamed watercourse	Excavation of peat prior to construction would reduce and mitigate risk of peat landslide to the north-east. Suitable shoring of excavations would assist in mitigating risk during construction. Benching of slopes along tracks would also mitigate against risk. Maintaining drainage pathways will reduce risk of peat slide. Good construction practices, as detailed in section 6.3 and 6.4, should be followed to mitigate against any instability.	Insignificant
13	Medium	Low	Significant	Excavated Track & T3	Unnamed watercourse	Excavation of peat prior to construction would reduce and mitigate risk of peat landslide to the north-west. Suitable shoring of excavations would assist in mitigating risk during construction. Benching of slopes along tracks would also mitigate against risk. Maintaining drainage pathways will reduce risk of peat slide. Good construction practices, as detailed in section 6.3 and 6.4, should be followed to mitigate against any instability.	Insignificant
14	Medium	Very Low	Insignificant	Floated Track	Unnamed watercourse	Floating track proposed along this area of access track, removing requirement to excavate and reducing risk of potential instability. Drainage pathways should be maintained during construction of track. Good construction practices, as detailed in section 6.3 and 6.4, should be followed to mitigate against any instability.	Insignificant
15	Medium	Low	Significant	Upgraded Track	Unnamed watercourse	Excavation of peat prior to construction would reduce and mitigate risk of peat landslide to the north. Suitable shoring of excavations would assist in mitigating risk during construction. Benching of slopes along tracks	Insignificant

Risk No.	Risk Rating	Impact Rating	Hazard Ranking	Infrastructure	Key Receptor	Mitigation	Revised Hazard Ranking
						would also mitigate against risk. Maintaining drainage pathways will reduce risk of peat slide. Good construction practices, as detailed in section 6.3 and 6.4, should be followed to mitigate against any instability.	

6.3 Good Practice During Construction

The paragraphs below detail good practice that is recommended during construction and follow the principles detailed in the NatureScot Guidance (2024)[23]. These measures are considered 'embedded mitigation' for the purposes of the assessment, and have been assumed to be in place for the purposes of the assessment presented in the EIA Report:

For excavated groundworks:

- Use of appropriate supporting structures around peat excavations to prevent collapse and the development of tension cracks;
- Avoid cutting trenches or aligning excavations across slopes (which may act as incipient head scarps for peat failures) unless appropriate mitigation has been put in place;
- Implement methods of working that minimise the cutting of the toes of slopes, e.g. working up-to downslope during excavation works;
- Monitor the ground upslope of excavation works for creep, heave, displacement, tension cracks, subsidence or changes in surface water content;
- Monitor cut faces for changes in water discharge, particularly at the peat-substrate contact; and
- Minimise the effects of construction on natural drainage by ensuring natural drainage pathways are maintained or diverted such that there is no significant alteration of the hydrological regime of the Proposed Development; drainage plans should avoid creating drainage/infiltration areas or settlement ponds towards the tops of slopes (where they may act to both load the slope and elevate pore pressures).

For cut tracks:

- Maintain drainage pathways through tracks to avoid ponding of water upslope;
- Monitor the top line of excavated peat deposits for deformation post-excavation; and
- Monitor the effectiveness of cross-track drainage to ensure water remains free-flowing and that no blockages have occurred.

For floating tracks:

- Prior to the construction, setting out the centre-line of the proposed track should include a walk over performed by the site manager or general foreman, along with the suitably qualified Geotechnical Engineer, and appropriate Clerk of Works. This should be carried out to check that the ground conditions/drainage paths are as expected, and “fine-tuning/micrositing” of the alignment if required;
- Weather policy should be agreed and implemented during works, e.g. identifying ‘stop’ rules (i.e. weather dependent criteria) for cessation of track construction or trafficking (e.g. allowing tracks to thaw following periods of hard frost); and
- Allow peat to undergo primary consolidation by adopting rates of road construction appropriate to weather conditions.

---

[23] NatureScot (July 2024), Good Practice During Wind Farm Construction. https://www.nature.scot/doc/good-practice-during-wind-farm-construction

Drainage measures:

- Development of drainage systems that would not create areas of concentrated flow or cause over, or under-saturation of peat habitats;
- Development of robust drainage systems that would require minimal maintenance;
- A robust design of drainage systems and associated measures (i.e. silt traps, etc.) to minimise sedimentation into natural watercourses. These should be maintained, and silt build up should be removed regularly;
- Method statements should be prepared in advance to mitigate against a slide occurring and should include, but not be limited to, the use of check dams/water bars and scour/erosion protection to limit flows and prevent contamination of watercourses; and
- Measures should be put in place to ensure drainage systems are well maintained, to include the identification and demarcation of zones of sensitive drainage or hydrology in areas of construction, e.g. inclusion of maintenance regimes for drainage systems into the CEMP.

For storage of peat (temporary):

- Suitable locations for permanent or temporary storage should be identified prior to the construction of the development once the phasing of the construction works have been determined and requirement for such locations deemed necessary;
- No peat is to be stored in the vicinity of any areas identified with ‘medium’ or ‘high’ peat landslide likelihoods;
- Detailed ground investigation and slope stability analysis to be undertaken at each potential peat storage areas by a suitability qualified geotechnical engineer;
- Suitable and robust control measures should be incorporated into the design of storage areas;
- No temporary storage of peat is to placed on areas with peat depths recorded between >0.5 m;
- Ensure adequate drainage is maintained for any peat storage areas;
- Minimise haul distances for peat, storing as near to excavation as possible; and
- Monitor effects of wetting / re-wetting stored peat on surrounding peat areas, and prevent water build up on the upslope side of peat mounds. Mitigate any run-off.

In addition to these control measures, the following good practice should be followed:

- A geotechnical risk register (GRR) should be prepared for the Proposed Development following intrusive investigations post-consent and location specific stability analyses – the risk register should be considered a live document and updated with Site experience as infrastructure is constructed;
- All construction activities and operational decisions that involve disturbance to peat deposits should be overseen by an appropriately qualified geotechnical engineer with experience of construction on peat sites;
- Awareness of peat instability and pre-failure indicators should be incorporated in Site induction and training to enable all site personnel to recognise ground disturbances and features indicative of incipient instability;
- Monitoring checklists should be prepared with respect to peat instability addressing all construction activities proposed for the Site;

- A documented procedure shall be in place and rapid reaction strategy in place prior to the commencement of construction on peat land. This strategy shall be enacted should signs of peat movement be recorded across the proposed development. This approach requires periodic and continued monitoring of the construction process by a suitably qualified Geotechnical Engineer;
- A detailed CEMP shall be produced and incorporate the conclusions of the peat stability report, continuously update the assessment and develop appropriate mitigations to respond to the peat slide risk as development proceeds;
- As part of the GRR, regular inspection and monitoring of stored peat should be undertaken until temporary storage has been completed. This involves with recording of any visual signs of ground movement including identification of tension cracking or slumping of peat material. Future inspection frequency would be determined post construction and be dependent upon meteorological conditions; and
- Awareness of peat instability and pre-failure indicators should be incorporated in Site induction and training to enable all Site personnel to recognise ground disturbances and features indicative of incipient instability.

6.4 Good Practice During Operation

Following cessation of construction activities, the following activities will be built into any monitoring of groundworks undertaken for the Proposed Development:

- Ponding on the upslope side of infrastructure sites and on the upslope side of access tracks;
- Subsidence and lateral displacement of tracks;
- Blockage or underperformance of the installed site drainage system;
- Slippage or creep of stored peat deposits; and
- Development of tension cracks, compression features, bulging or quaking bog anywhere in a 50m corridor surrounding the Proposed Development or any construction activities or Site works.

This monitoring should be undertaken on a quarterly basis in the first year after construction, biannually in the second year after construction and annually thereafter; in the event that unanticipated ground conditions arise during construction, the frequency of these intervals should be reviewed, revised and justified accordingly.

7.0 Conclusion

The report has highlighted the complicated inter-relationship between all the aspects that have an effect on the stability of peat. Consequently, the discussion has also addressed areas of construction and drainage in order to avoid a stability problem rather than attempt to put it right after the event. The Proposed Development has been assessed for potential hazards associated with peat instability; the assessment has been based on:

- A walk-over survey by an experienced Geologist;
- A thorough inspection of the digital terrain map;
- Review of historical and geological maps and publications and aerial photography; and
- A detailed geotechnical probing exercise at 10,641 locations in areas of identified peaty soil/peat to determine the thickness thereof.

Peat probing fieldworks have indicated that 60% of peat probe locations encountered <0.5 m of peat. 31% of probe locations identified peat between 0.5 to 1.5 m, and the remaining 8% of probe locations encountered peat depths >1.5 m. The PLHRA method has been developed by SLR and described within this report. The results indicate that 4% of probe locations are at medium risk of peat instability.

The overall conclusion regarding peat stability indicates that there is a negligible to low risk of peat instability over most of the Site although some areas of medium and high risk have been identified. For these areas, a hazard impact assessment was completed which concluded that, subject to micro-siting and the employment of appropriate mitigation measures, all these areas can be considered as an insignificant hazard.

Additional mitigation measures have been identified in areas where hazards are already considered insignificant to further reduce the risk of potential hazards occurring.

The entire Site can be considered to be extensively covered in peat with a maximum recorded thickness of 4.7m on the flatter areas. The locally thicker areas of peat have been avoided through layout design.

The report has highlighted the complicated inter-relationship between all the aspects that have an effect on the stability of peat. Consequently, the discussion has also addressed areas of construction and drainage in order to avoid a stability problem rather than attempt to put it right after the event.

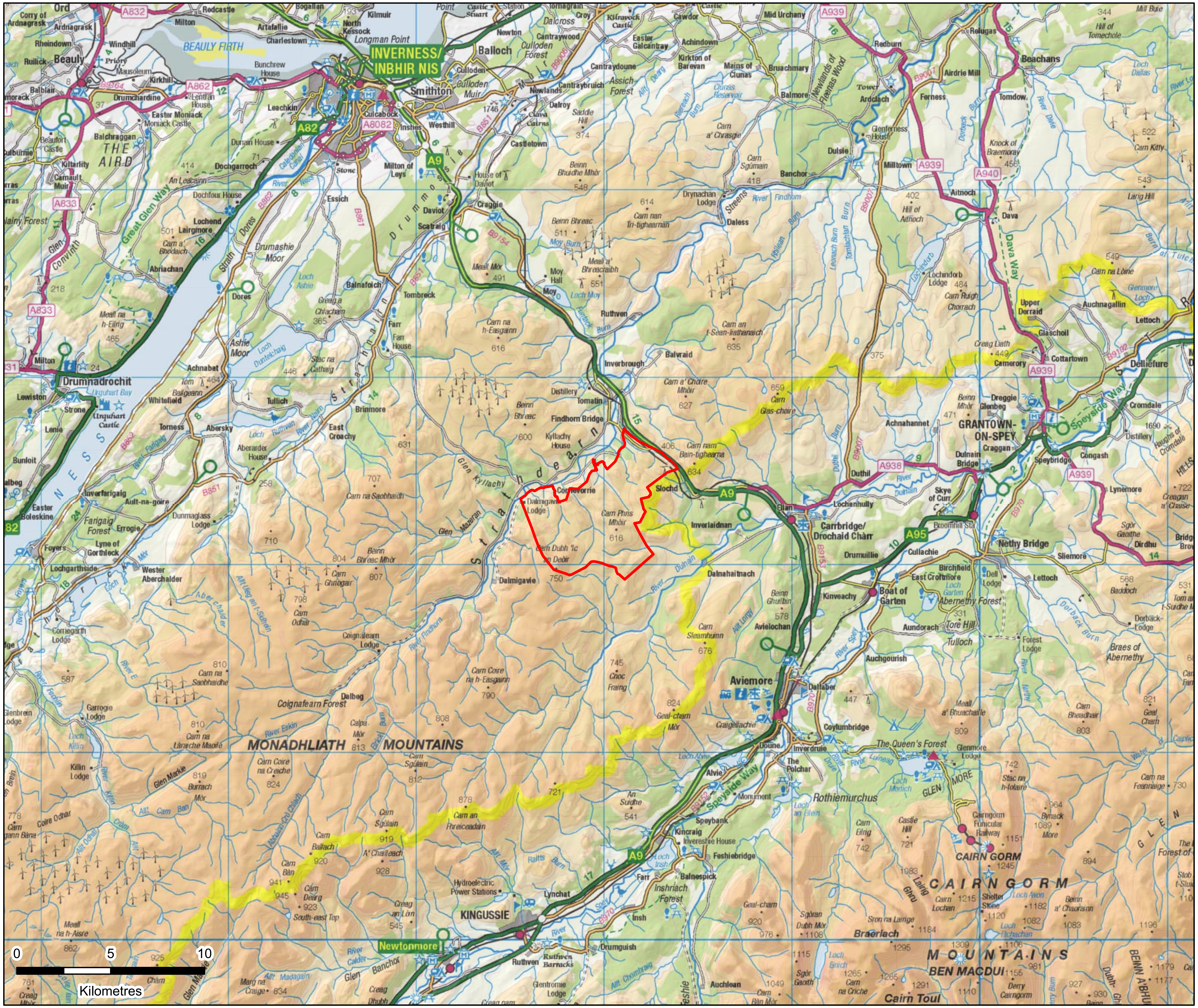
Figures

Technical Appendix 9.1: Peat Landslide Hazard Risk Assessment

Clune Wind Farm

Renewable Energy Systems Ltd

SLR Project No.: 405.064807.00001



CLUNE WIND FARM
EIA REPORT

FIGURE 9.1.1

SITE LOCATION

▭ Site Boundary

LAYOUT DWG: NA

T-LAYOUT NO.: PSCOCLU041

DRAWING NUMBER: 405.064807.00001.0071.0

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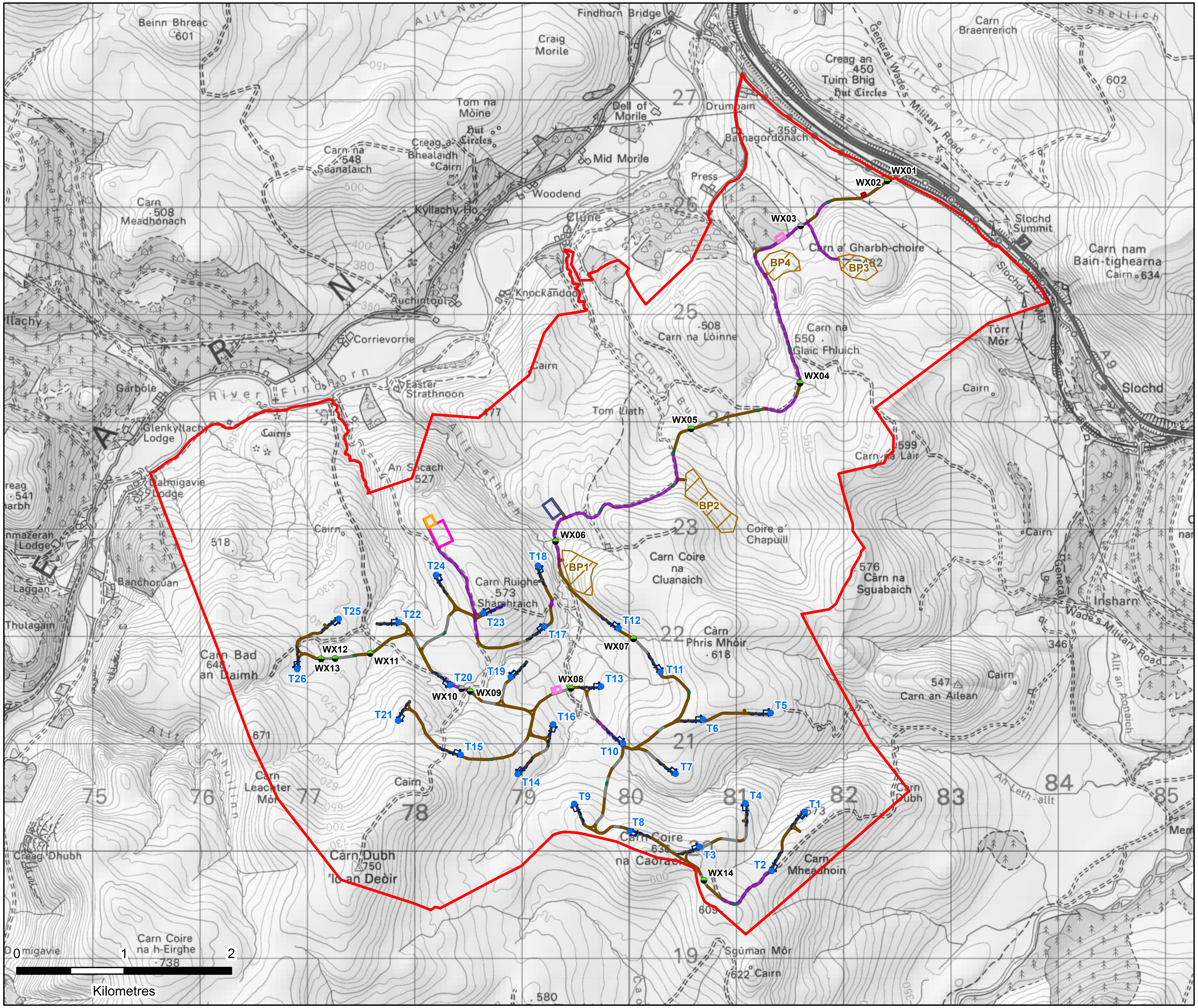

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CLUNE WIND FARM EIA REPORT

FIGURE 9.1.2

SITE LAYOUT

🟥	Site Boundary
●	Proposed Turbine Location
●	Proposed Watercourse Crossing
●	Existing Watercourse Crossing
☐	Proposed Substation Compound
▨	Proposed Hardstanding
▨	Proposed Temporary Construction Compound
▨	Proposed Borrow Pit Search Area
☐	Proposed Gatehouse Compound
☐	Proposed Passing Place
☐	Proposed Batching Plant
☐	Proposed Battery Energy Storage System (BESS)
☐	Proposed Floated Track
☐	Proposed Site Track
☐	Existing Track to be Upgraded

LAYOUT DWG	T-LAYOUT NO.
NA	PSCOCLU041

DRAWING NUMBER
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SCALE - 1:35,000 @ A3

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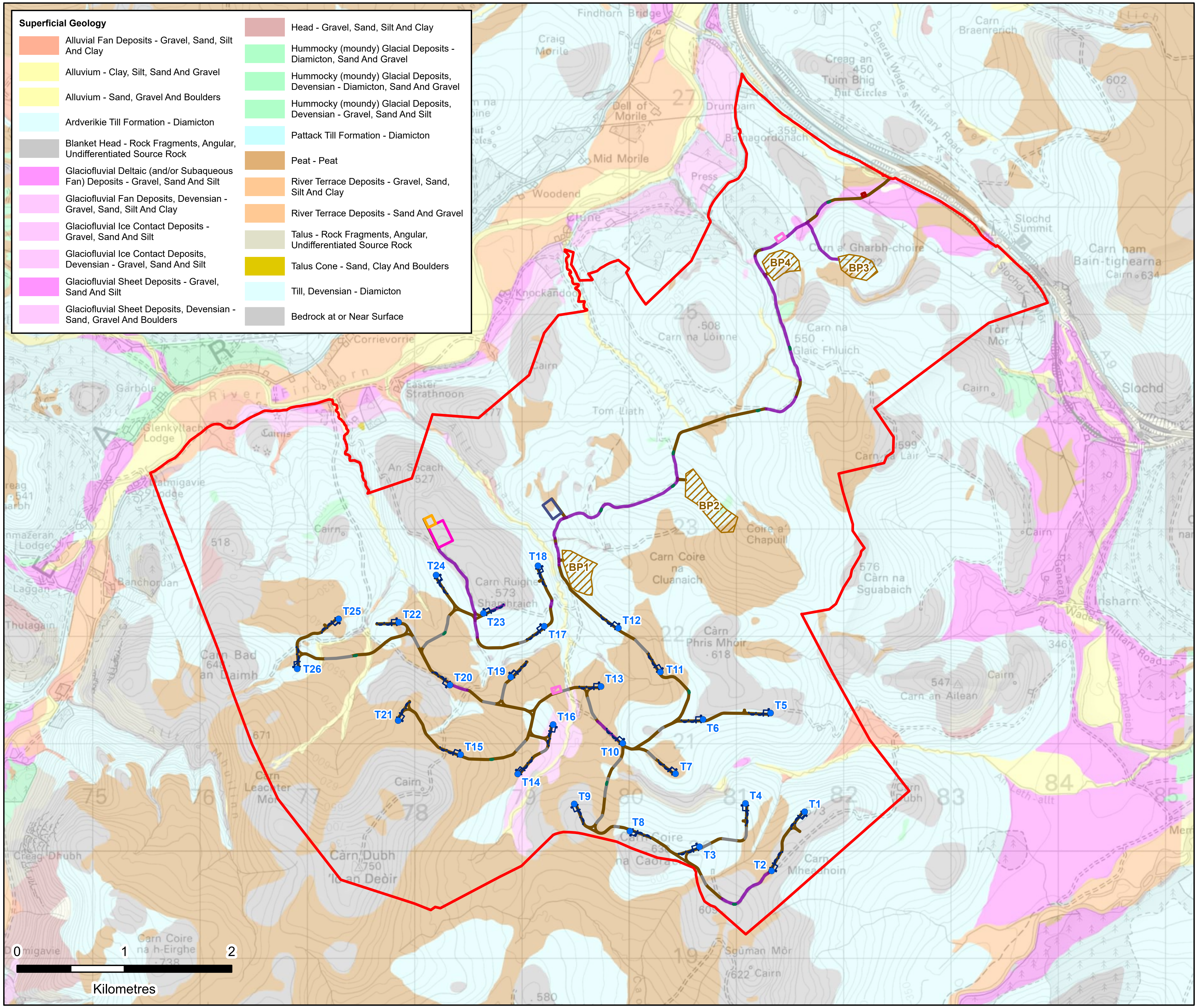

Superficial Geology

- Alluvial Fan Deposits - Gravel, Sand, Silt And Clay
- Alluvium - Clay, Silt, Sand And Gravel
- Alluvium - Sand, Gravel And Boulders
- Ardverikie Till Formation - Diamicton
- Blanket Head - Rock Fragments, Angular, Undifferentiated Source Rock
- Glaciofluvial Deltaic (and/or Subaqueous Fan) Deposits - Gravel, Sand And Silt
- Glaciofluvial Fan Deposits, Devensian - Gravel, Sand, Silt And Clay
- Glaciofluvial Ice Contact Deposits - Gravel, Sand And Silt
- Glaciofluvial Ice Contact Deposits, Devensian - Gravel, Sand And Silt
- Glaciofluvial Sheet Deposits - Gravel, Sand And Silt
- Glaciofluvial Sheet Deposits, Devensian - Sand, Gravel And Boulders
- Head - Gravel, Sand, Silt And Clay
- Hummocky (moundy) Glacial Deposits - Diamicton, Sand And Gravel
- Hummocky (moundy) Glacial Deposits, Devensian - Diamicton, Sand And Gravel
- Hummocky (moundy) Glacial Deposits, Devensian - Gravel, Sand And Silt
- Pattack Till Formation - Diamicton
- Peat - Peat
- River Terrace Deposits - Gravel, Sand, Silt And Clay
- River Terrace Deposits - Sand And Gravel
- Talus - Rock Fragments, Angular, Undifferentiated Source Rock
- Talus Cone - Sand, Clay And Boulders
- Till, Devensian - Diamicton
- Bedrock at or Near Surface

CLUNE WIND FARM EIA REPORT

FIGURE 9.1.3

SUPERFICIAL GEOLOGY

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- Site Boundary
- Proposed Turbine Location
- Proposed Substation Compound
- Proposed Hardstanding
- Proposed Temporary Construction Compound
- Proposed Borrow Pit Search Area
- Proposed Gatehouse Compound
- Proposed Passing Place
- Proposed Batching Plant
- Proposed Battery Energy Storage System (BESS)
- Proposed Floated Track
- Proposed Site Track
- Existing Track to be Upgraded

LAYOUT DWG	T-LAYOUT NO.
NA	PSCOCLU041

DRAWING NUMBER
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SCALE - 1:35,000 @ A3

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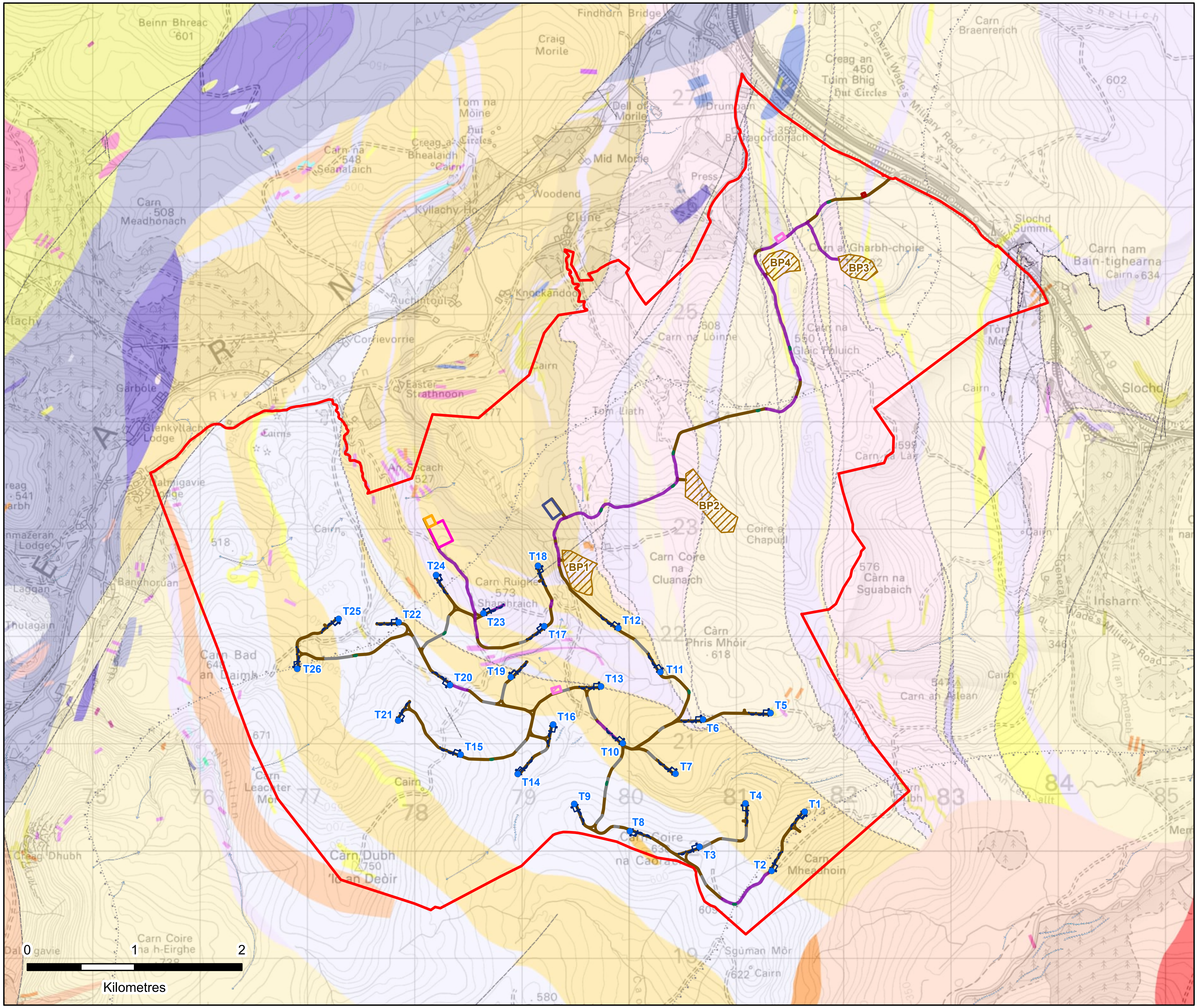

CLUNE WIND FARM
EIA REPORT

FIGURE 9.1.4A

BEDROCK GEOLOGY

🟥	Site Boundary
●	Proposed Turbine Location
☐	Proposed Substation Compound
▨	Proposed Hardstanding
▨	Proposed Temporary Construction Compound
▨	Proposed Borrow Pit Search Area
☐	Proposed Gatehouse Compound
☐	Proposed Passing Place
☐	Proposed Batching Plant
☐	Proposed Battery Energy Storage System (BESS)
☐	Proposed Floated Track
☐	Proposed Site Track
☐	Existing Track to be Upgraded

Note: Bedrock geology legend is visible on Figure 9.1.4B.

LAYOUT DWG
NA

T-LAYOUT NO.
PSCOCLU041

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Bedrock Geology

Metamorphic Rocks

Tonian / Ediacaran

- ⬜ Ardair Semipelite Formation - Semipelite
- 🟦 Dalradian Supergroup - Metalimestone
- ⬜ Dalradian Supergroup - Phyllitic Semipelite, Calcsilicate-rock And Metalimestone
- 🟨 Dalradian Supergroup - Psammite And Micaceous Psammite
- ⬜ Dalradian Supergroup - Psammite, Semipelite And Calcsilicate-rock
- 🟨 Dalradian Supergroup - Quartzite
- ⬜ Dalradian Supergroup - Semipelite, Gneissose
- ⬜ Elrick Psammite And Semipelite Formation - Psammite
- 🟨 Elrick Psammite And Semipelite Formation - Quartzite
- ⬜ Kincraig Formation - Calcsilicate-rock
- 🟦 Kincraig Formation - Pelite
- 🟨 Kincraig Formation - Quartzite
- ⬜ Kincraig Formation - Semipelite, Gneissose
- 🟪 Loch Laggan Psammite Formation - Psammite And Semipelite
- 🟫 Loch Laggan Psammite Formation - Psammite, Micaceous
- ⬜ Ruthven Semipelite Formation - Psammite, Semipelite And Calcsilicate-rock
- 🟨 Unnamed Metamorphic Rocks, Neoproterozoic - Amphibolite
- 🟫 Unnamed Metamorphic Rocks, Neoproterozoic - Metagabbro And Metamicrogabbro
- 🟩 Unnamed Metamorphic Rocks, Neoproterozoic - Para-amphibolite

Igneous Rocks

Silurian / Devonian

- 🟦 Findhorn Pluton - Diorite And Monzodiorite
- 🟥 Monadhliath Pluton - Microgranite, Aplitic
- 🟪 North Britain Siluro-devonian Calc-alkaline Dyke Suite - Diorite
- 🟧 North Britain Siluro-devonian Calc-alkaline Dyke Suite - Felsite
- 🟩 North Britain Siluro-devonian Calc-alkaline Dyke Suite - Intrusion-breccia And Tuffisite
- 🟪 North Britain Siluro-devonian Calc-alkaline Dyke Suite - Microdiorite
- 🟧 North Britain Siluro-devonian Calc-alkaline Dyke Suite - Microgranodiorite
- 🟪 North Britain Siluro-devonian Calc-alkaline Dyke Suite - Micromonzodiorite

Silurian

- 🟪 Findhorn Pluton, Phase 1 - Granodiorite, Hornblende-biotite
- 🟪 Findhorn Pluton, Phase 2 - Granodiorite, Biotite
- 🟥 Monadhliath Pluton, Phase 1 - Granite, Porphyritic
- ⬜ Monadhliath Pluton, Phase 2 - Monzogranite, Biotite
- 🟧 Monadhliath Pluton, Phase 3 - Microgranite
- 🟨 Monadhliath Pluton, Phase 4 - Microgranite, Aplitic-porphyritic

Ordovician

- 🟥 Glen Kyllachy Pluton - Granite, Foliated
- 🟥 Scottish Highland Ordovician Minor Intrusion Suite - Leucogranite
- 🟪 Scottish Highland Ordovician Minor Intrusion Suite - Leucogranite, Pegmatitic
- 🟪 Scottish Highland Ordovician Minor Intrusion Suite - Pegmatite

Linear Geology

- — Backfeature Terrace
- +++++ Esker Crestline
- — — Fault Inferred
- —▲ Fault Thrust Inf Triangle on Hangingwall Side
- ←● Glacial Meltwater Channel Centre Undiff
- ┴┴ Glacial Meltwater Channel Margin
- —● Ice Margin Glacial Meltwater Channel Left
- · ·+· · Limit Metamorphic Aureole
- ~ ~ Shear Zone Inf

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FIGURE 9.1.4B

BEDROCK GEOLOGY

LAYOUT DWG NA

T-LAYOUT NO. PSCOCLU041

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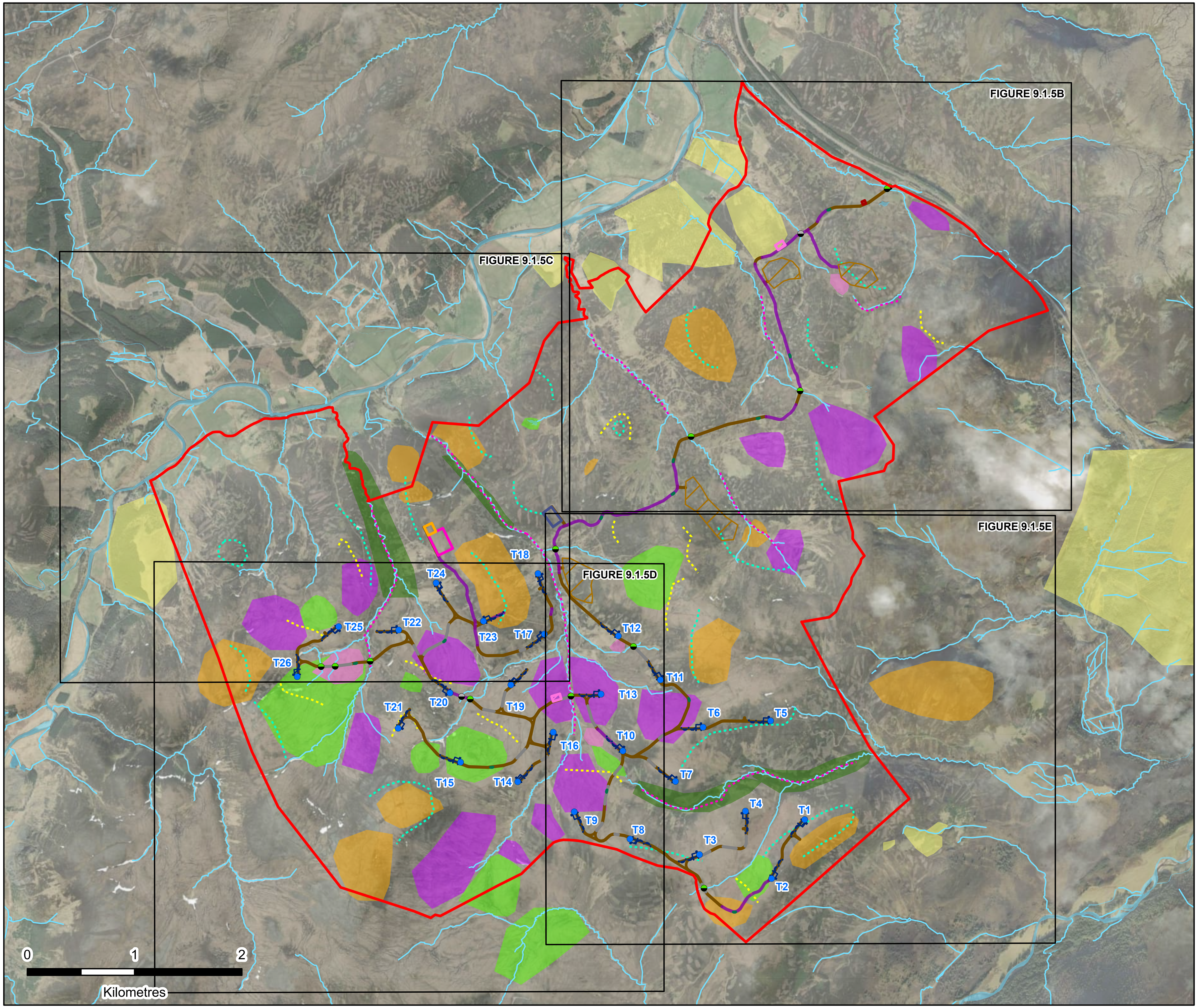

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FIGURE 9.1.5A

GEOMORPHOLOGY

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Aerial Imagery (2021) Source: Earthstar Geographics

- Site Boundary
- ● Proposed Turbine Location
- ● Proposed Watercourse Crossing
- ● Existing Watercourse Crossing
- Proposed Substation Compound
- Proposed Hardstanding
- Proposed Temporary Construction Compound
- Proposed Borrow Pit Search Area
- Proposed Gatehouse Compound
- Proposed Passing Place
- Proposed Batching Plant
- Proposed Battery Energy Storage System (BESS)
- Proposed Floated Track
- Proposed Site Track
- Existing Track to be Upgraded

Geomorphology

- Slope Bottom
- Slope Top
- Break in Slope
- Bedrock
- Blanket Bog
- Forestry and Artifical Drainage
- Furrow
- Gulley
- Peat Hagg
- Watercourse (OS OpenMap Local)
- Waterbody (OS OpenMap Local)

LAYOUT DWG	T-LAYOUT NO.
TBC	PSCOCLU041

DRAWING NUMBER
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SCALE - 1:35,000 @ A3

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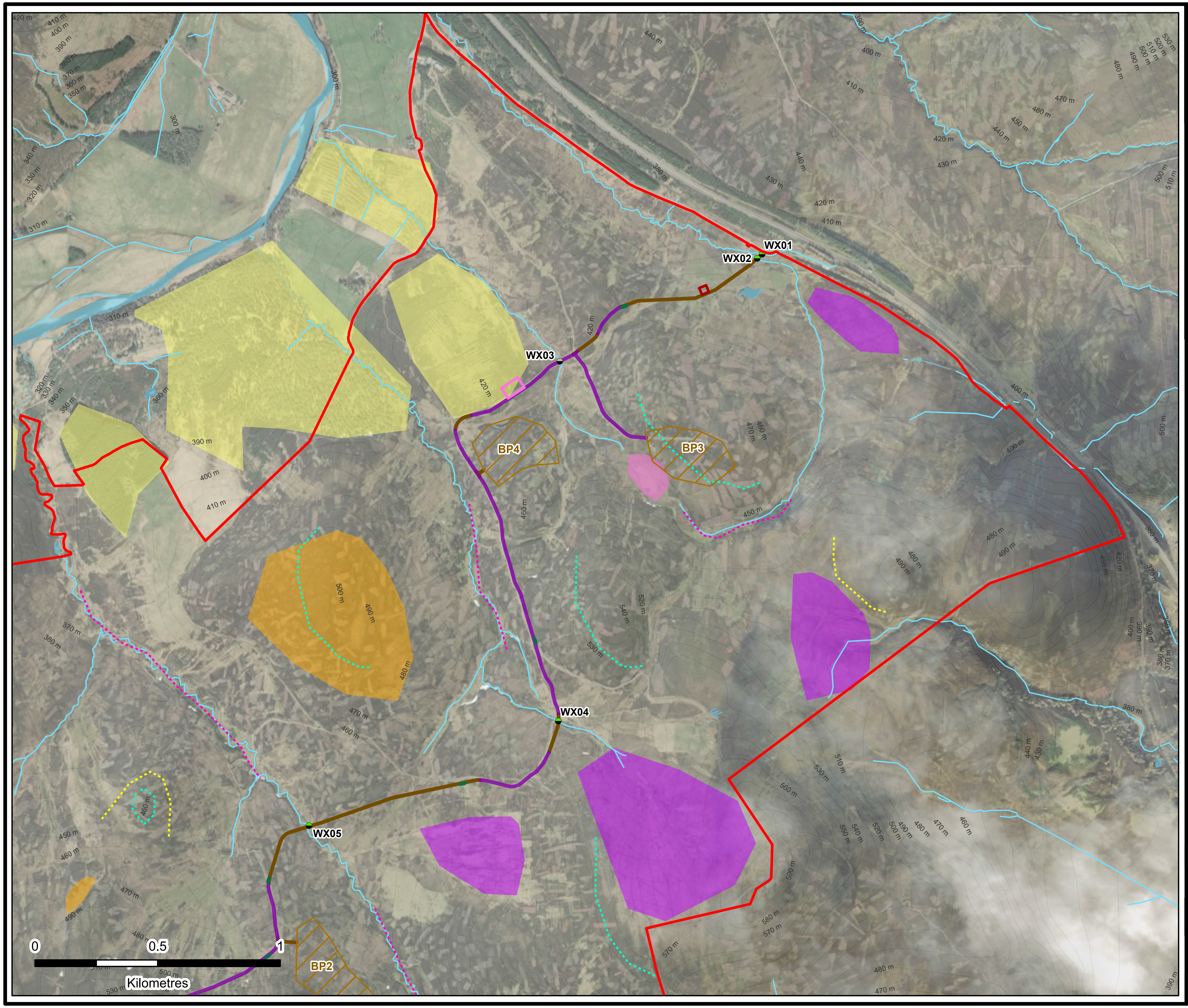

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FIGURE 9.1.5B

GEOMORPHOLOGY

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- 🟥 Site Boundary
- ● Proposed Watercourse Crossing
- ● Existing Watercourse Crossing
- ▨ Proposed Temporary Construction Compound
- ▨ Proposed Borrow Pit Search Area
- 🟥 Proposed Gatehouse Compound
- 🟩 Proposed Passing Place
- 🟫 Proposed Site Track
- 🟪 Existing Track to be Upgraded

Geomorphology

- ┅ Slope Bottom
- ┅ Slope Top
- ┅ Break in Slope
- 🟧 Bedrock
- 🟪 Blanket Bog
- 🟨 Forestry and Artifical Drainage
- 🟪 Furrow
- — Watercourse (OS OpenMap Local)
- 🟦 Waterbody (OS OpenMap Local)

LAYOUT DWG	T-LAYOUT NO.
TBC	PSCOCLU041

DRAWING NUMBER
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SCALE - 1:15,000 @ A3

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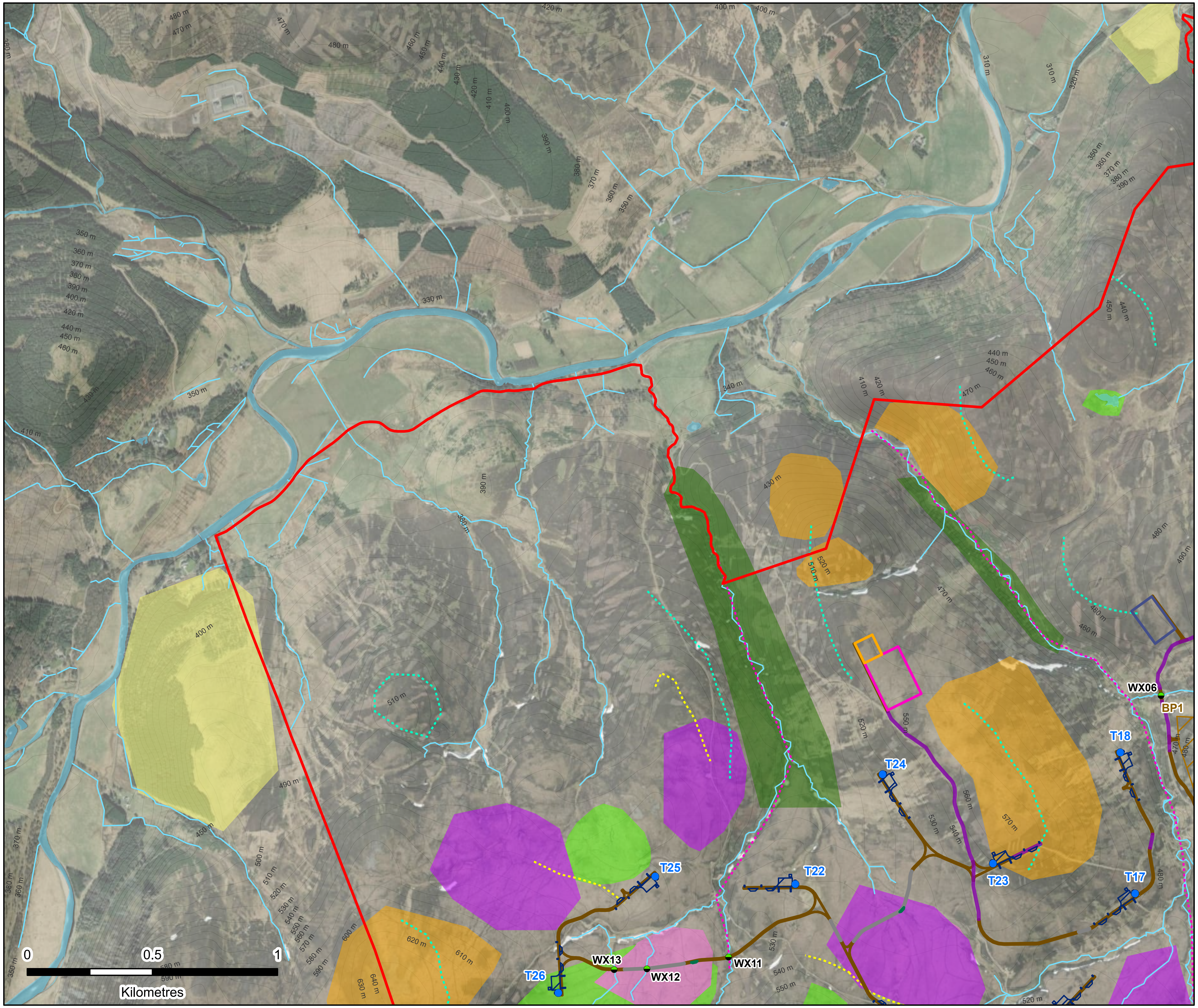

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FIGURE 9.1.5C

GEOMORPHOLOGY

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- 🟥 Site Boundary
- ● Proposed Turbine Location
- ● Proposed Watercourse Crossing
- ▭ Proposed Substation Compound
- ▨ Proposed Hardstanding
- ▨ Proposed Borrow Pit Search Area
- ▭ Proposed Passing Place
- ▭ Proposed Batching Plant
- ▭ Proposed Battery Energy Storage System (BESS)
- ▭ Proposed Floated Track
- ▭ Proposed Site Track
- ▭ Existing Track to be Upgraded

Geomorphology

- ┅ Slope Bottom
- ┅ Slope Top
- ┅ Break in Slope
- 🟧 Bedrock
- ■ Blanket Bog
- 🟨 Forestry and Artifical Drainage
- 🟪 Furrow
- 🟩 Gulley
- 🟩 Peat Hagg
- ─ Watercourse (OS OpenMap Local)
- ■ Waterbody (OS OpenMap Local)

LAYOUT DWG	T-LAYOUT NO.
TBC	PSCOCLU041

DRAWING NUMBER
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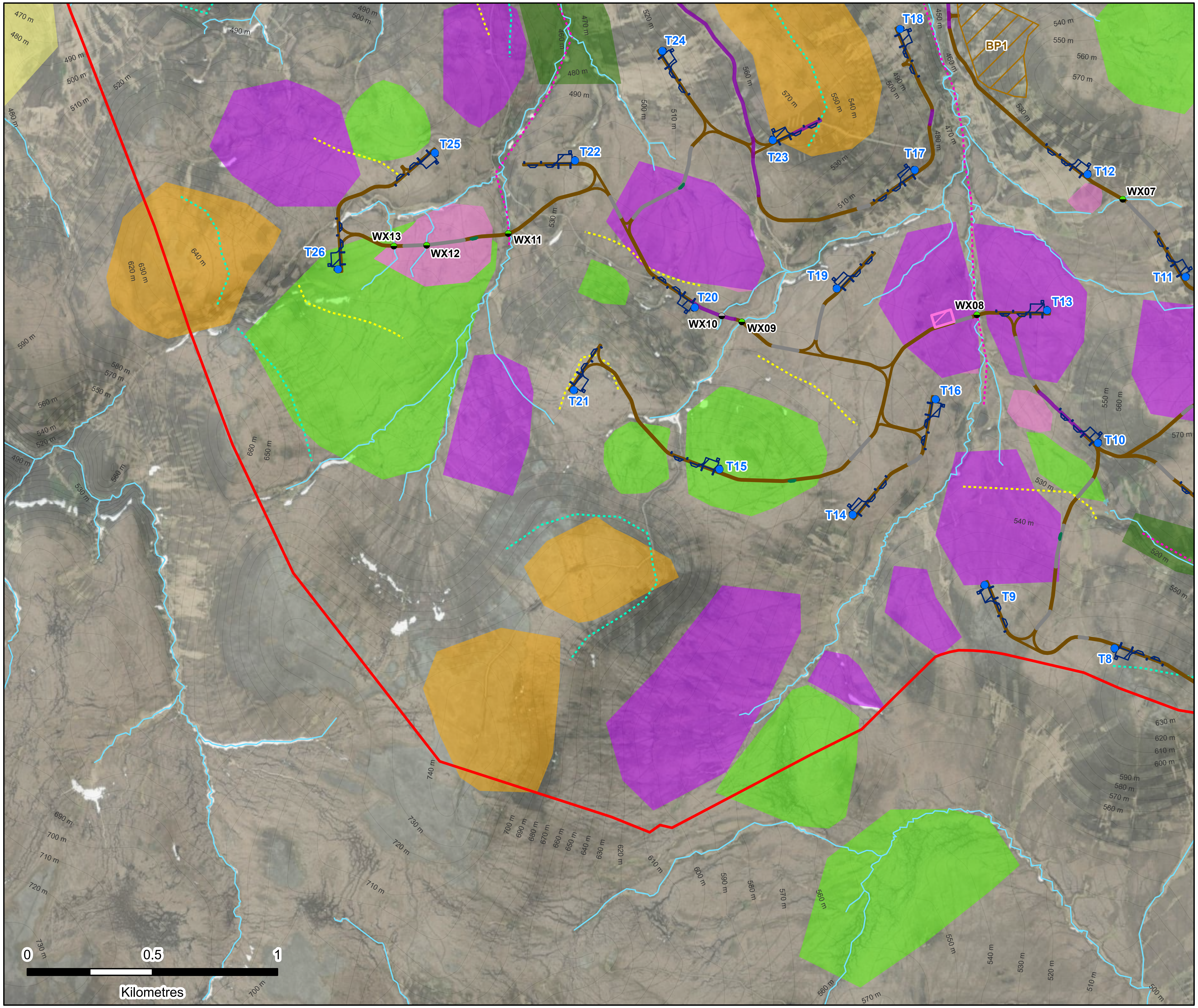

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FIGURE 9.1.5D

GEOMORPHOLOGY

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- Site Boundary
- Proposed Turbine Location
- Proposed Watercourse Crossing
- Existing Watercourse Crossing
- Proposed Hardstanding
- Proposed Temporary Construction Compound
- Proposed Borrow Pit Search Area
- Proposed Passing Place
- Proposed Floated Track
- Proposed Site Track
- Existing Track to be Upgraded

Geomorphology

- Slope Bottom
- Slope Top
- Break in Slope
- Bedrock
- Blanket Bog
- Forestry and Artifical Drainage
- Furrow
- Gulley
- Peat Hagg
- Watercourse (OS OpenMap Local)
- Waterbody (OS OpenMap Local)

LAYOUT DWG	T-LAYOUT NO.
TBC	PSCOCLU041

DRAWING NUMBER
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SCALE - 1:15,000 @ A3

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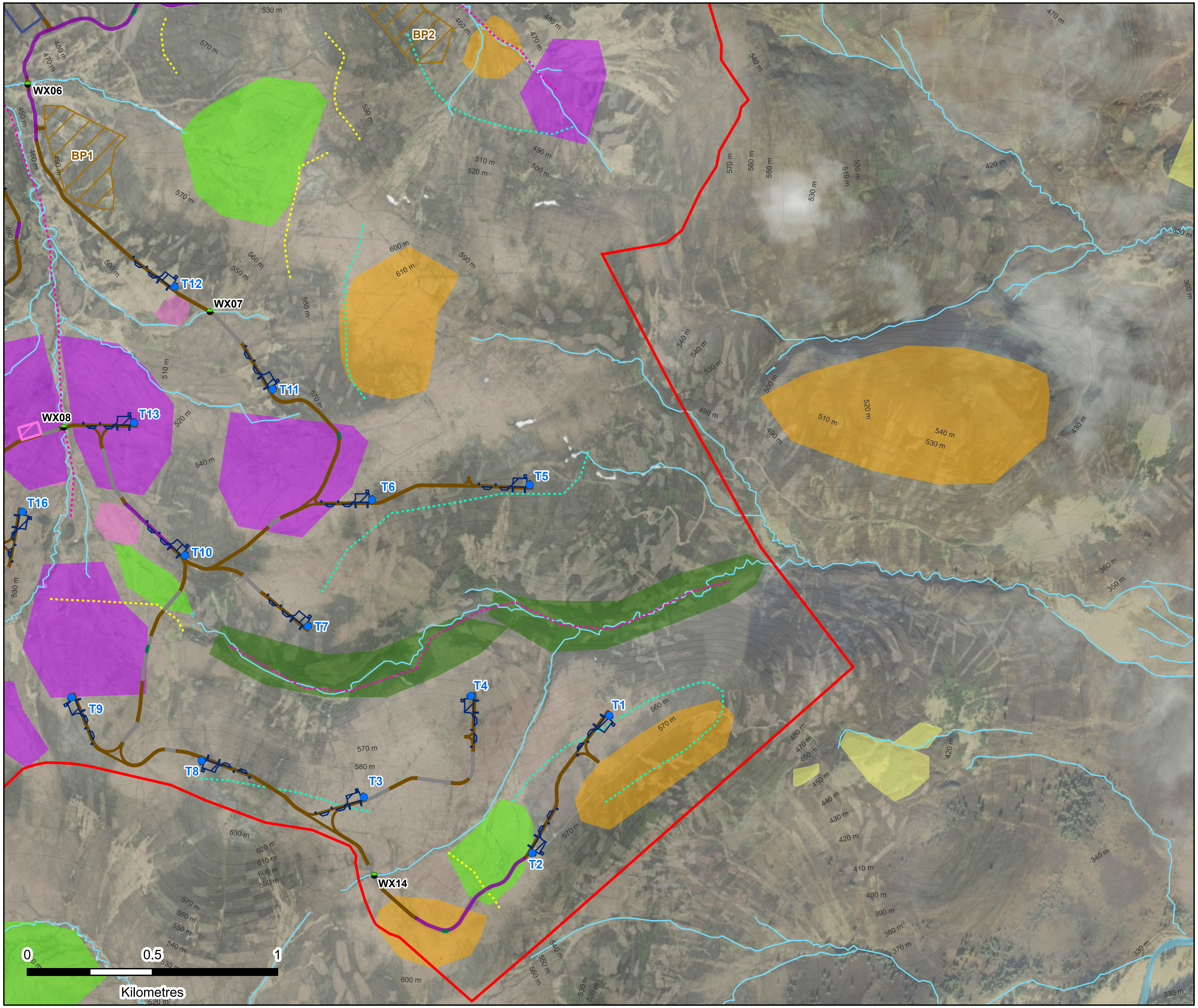

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FIGURE 9.1.5E

GEOMORPHOLOGY

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- 🟥 Site Boundary
- ● Proposed Turbine Location
- ● Proposed Watercourse Crossing
- ▨ Proposed Hardstanding
- ▨ Proposed Temporary Construction Compound
- ▨ Proposed Borrow Pit Search Area
- ▭ Proposed Passing Place
- ▭ Proposed Batching Plant
- ▭ Proposed Floated Track
- ▭ Proposed Site Track
- ▭ Existing Track to be Upgraded

Geomorphology

- ⋯ Slope Bottom
- ⋯ Slope Top
- ⋯ Break in Slope
- 🟧 Bedrock
- 🟪 Blanket Bog
- 🟨 Forestry and Artifical Drainage
- 🟪 Furrow
- 🟩 Gulley
- 🟩 Peat Hagg
- — Watercourse (OS OpenMap Local)
- 🟦 Waterbody (OS OpenMap Local)

LAYOUT DWG	T-LAYOUT NO.
TBC	PSCOCLU041

DRAWING NUMBER
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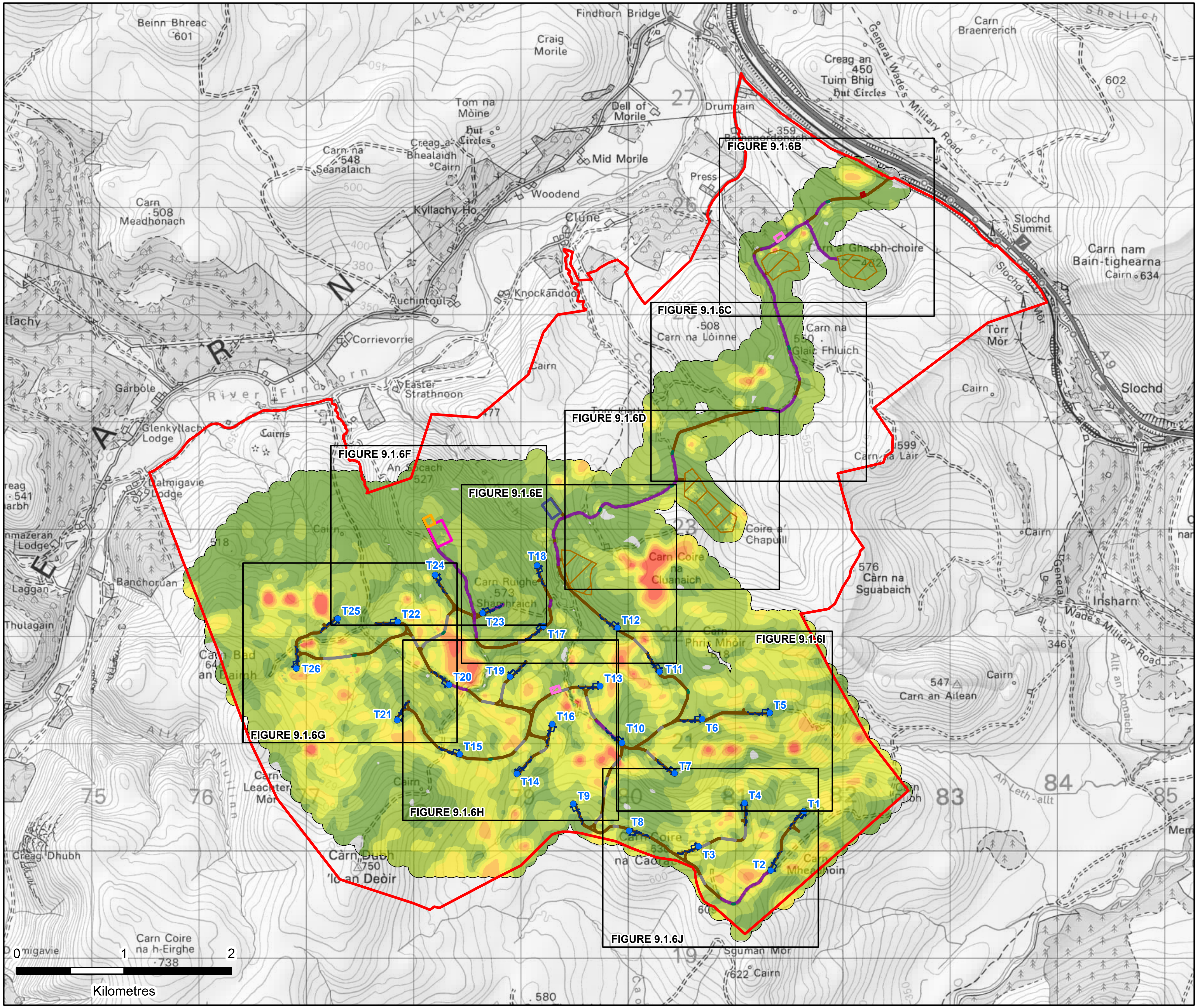

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CLUNE WIND FARM EIA REPORT

FIGURE 9.1.6A

PEAT DEPTH

🟥	Site Boundary
●	Proposed Turbine Location
🟧	Proposed Substation Compound
▨	Proposed Hardstanding
▨	Proposed Temporary Construction Compound
▨	Proposed Borrow Pit Search Area
🟥	Proposed Gatehouse Compound
🟩	Proposed Passing Place
🟦	Proposed Batching Plant
🟪	Proposed Battery Energy Storage System (BESS)
⬜	Proposed Floated Track
🟫	Proposed Site Track
🟪	Existing Track to be Upgraded

Peat Depth (m)

⬜	0
🟩	0 - 0.5
🟩	0.5 - 1
🟨	1 - 1.5
🟨	1.5 - 2
🟧	2 - 2.5
🟧	2.5 - 3
🟥	> 3

LAYOUT DWG NA

T-LAYOUT NO. PSCOCLU041

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ENVIRONMENTAL IMPACT ASSESSMENT REPORT 2025

CLUNE WIND FARM
EIA REPORT

FIGURE 9.1.6B

PEAT DEPTH

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- 🟥 Site Boundary
- ▨ Proposed Temporary Construction Compound
- ▨ Proposed Borrow Pit Search Area
- 🟥 Proposed Gatehouse Compound
- 🟩 Proposed Passing Place
- 🟫 Proposed Site Track
- 🟪 Existing Track to be Upgraded
- \+ Peat Probe

Peat Depth (m)

- ⬜ 0
- 🟩 0 - 0.5
- 🟩 0.5 - 1
- 🟨 1 - 1.5
- 🟨 1.5 - 2
- 🟧 2 - 2.5
- 🟧 2.5 - 3
- 🟥 > 3

LAYOUT DWG	T-LAYOUT NO.
NA	PSCOCLU041

DRAWING NUMBER
405.064807.00001.0077.0

SCALE - 1:6,000 @ A3

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FIGURE 9.1.6C

PEAT DEPTH

- 🟥 Site Boundary
- ▨ Proposed Borrow Pit Search Area
- 🟩 Proposed Passing Place
- 🟫 Proposed Site Track
- 🟪 Existing Track to be Upgraded
- + Peat Probe

Peat Depth (m)

- ⬜ 0
- 🟩 0 - 0.5
- 🟩 0.5 - 1
- 🟨 1 - 1.5
- 🟨 1.5 - 2
- 🟧 2 - 2.5
- 🟧 2.5 - 3
- 🟥 > 3

LAYOUT DWG NA	T-LAYOUT NO. PSCOCLU041

DRAWING NUMBER
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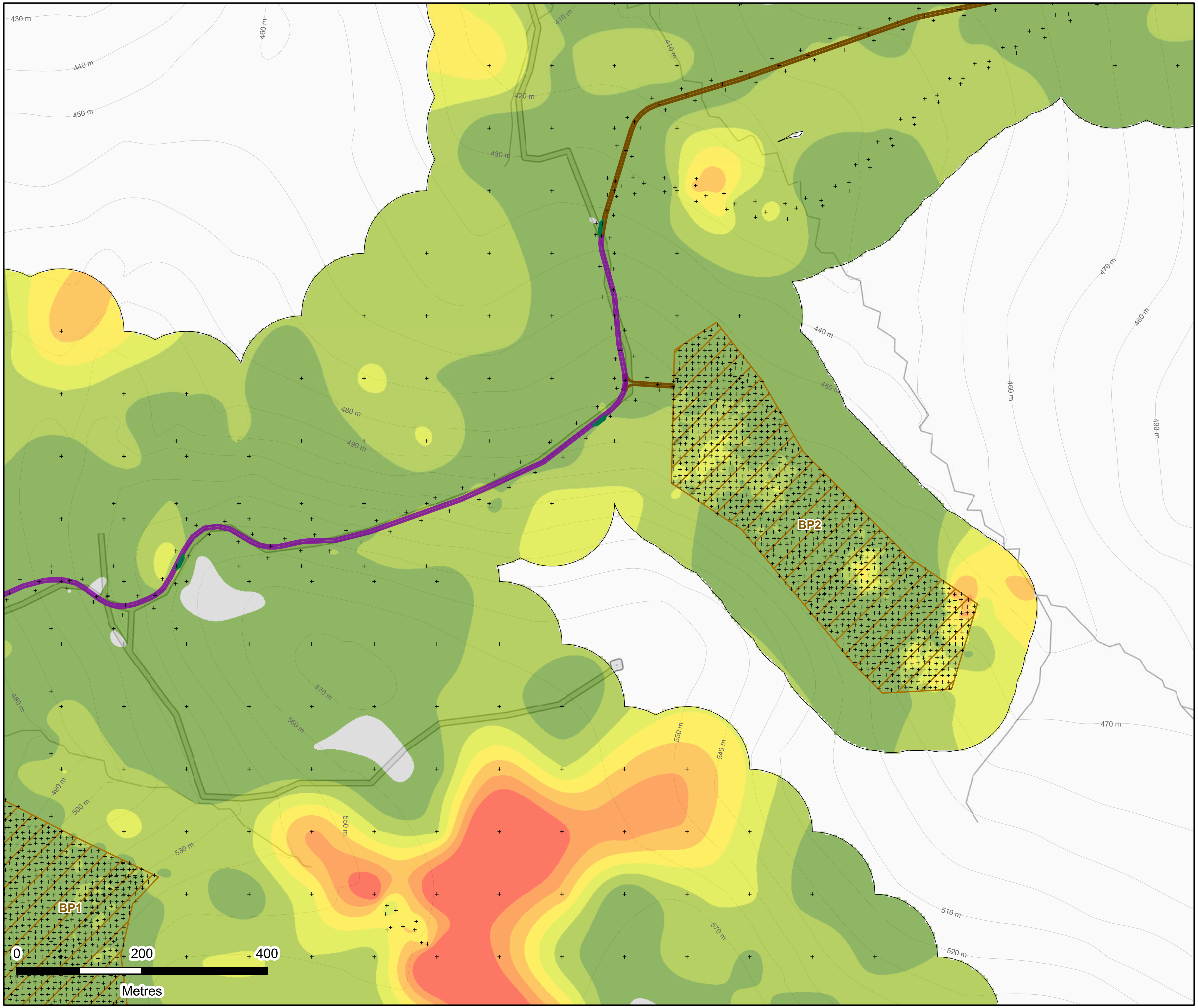

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FIGURE 9.1.6D

PEAT DEPTH

▭ Site Boundary
▨ Proposed Borrow Pit Search Area
▭ Proposed Passing Place
▭ Proposed Site Track
▭ Existing Track to be Upgraded
\+ Peat Probe

Peat Depth (m)

⬜ 0
🟩 0 - 0.5
🟩 0.5 - 1
🟨 1 - 1.5
🟨 1.5 - 2
🟧 2 - 2.5
🟧 2.5 - 3
🟥 > 3

LAYOUT DWG NA	T-LAYOUT NO. PSCOCLU041

DRAWING NUMBER
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SCALE - 1:6,000 @ A3

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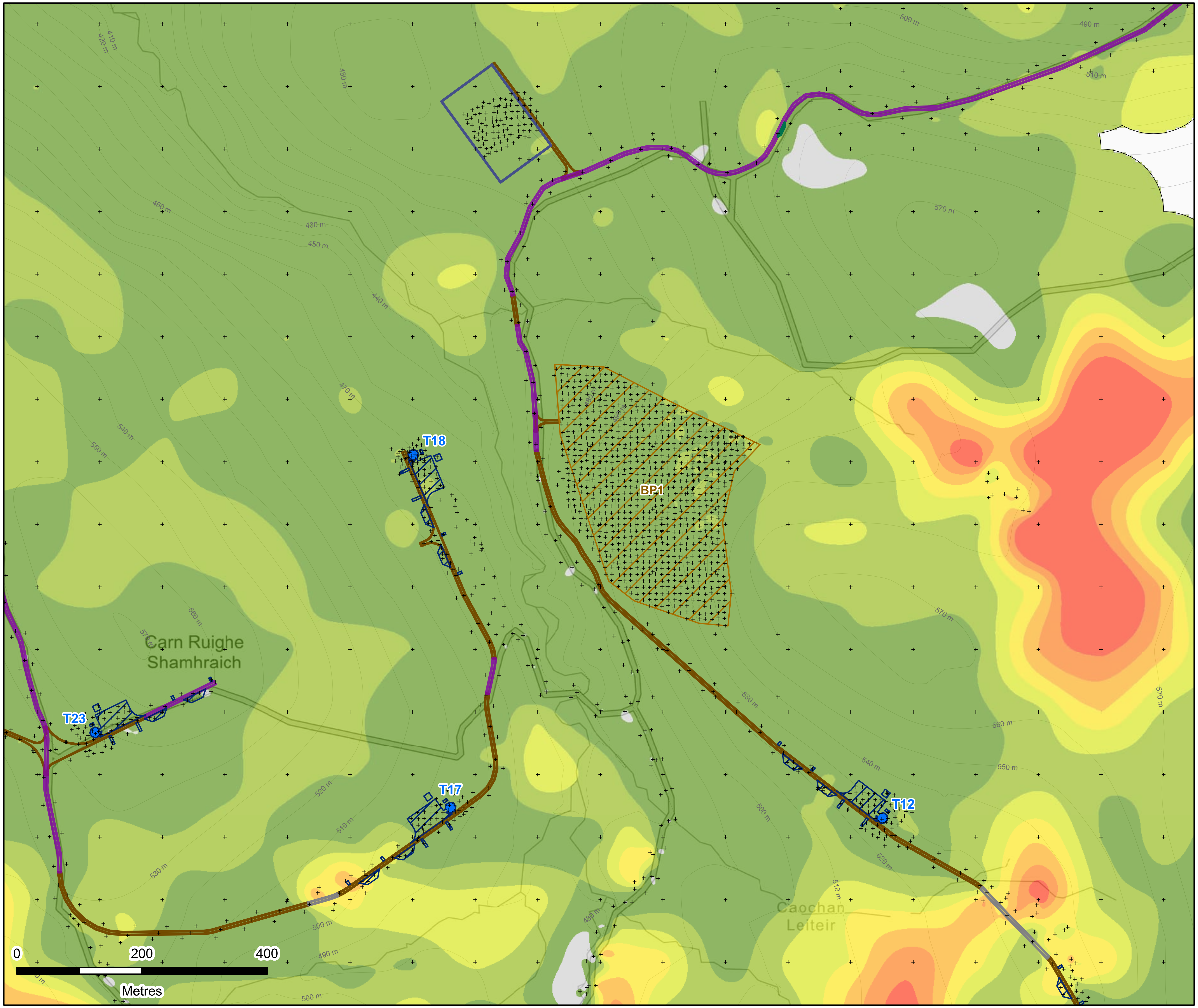

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FIGURE 9.1.6E

PEAT DEPTH

- 🟥 Site Boundary
- ● Proposed Turbine Location
- ▨ Proposed Hardstanding
- ▨ Proposed Borrow Pit Search Area
- 🟩 Proposed Passing Place
- ☐ Proposed Batching Plant
- ☐ Proposed Floated Track
- ☐ Proposed Site Track
- ☐ Existing Track to be Upgraded
- + Peat Probe

Peat Depth (m)

- 0
- 0 - 0.5
- 0.5 - 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.5
- 2.5 - 3
- > 3

LAYOUT DWG NA

T-LAYOUT NO. PSCOCLU041

DRAWING NUMBER

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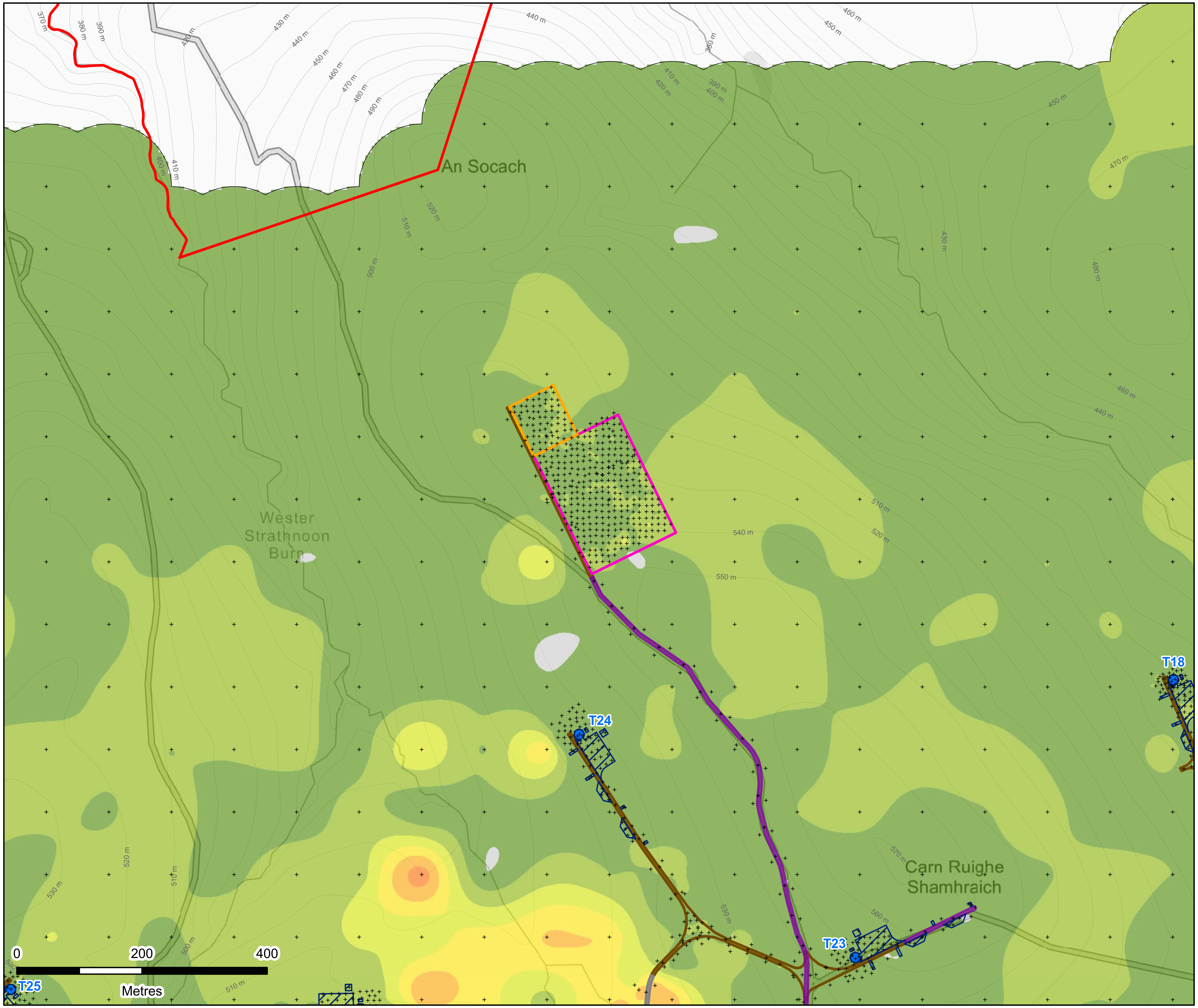

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FIGURE 9.1.6F

PEAT DEPTH

- ▭ Site Boundary
- ● Proposed Turbine Location
- ▭ Proposed Substation Compound
- ▨ Proposed Hardstanding
- ▭ Proposed Battery Energy Storage System (BESS)
- ▭ Proposed Floated Track
- ▭ Proposed Site Track
- ▭ Existing Track to be Upgraded
- \+ Peat Probe

Peat Depth (m)

- ■ 0
- ■ 0 - 0.5
- ■ 0.5 - 1
- ■ 1 - 1.5
- ■ 1.5 - 2
- ■ 2 - 2.5
- ■ 2.5 - 3

LAYOUT DWG	T-LAYOUT NO.
NA	PSCOCLU041

DRAWING NUMBER
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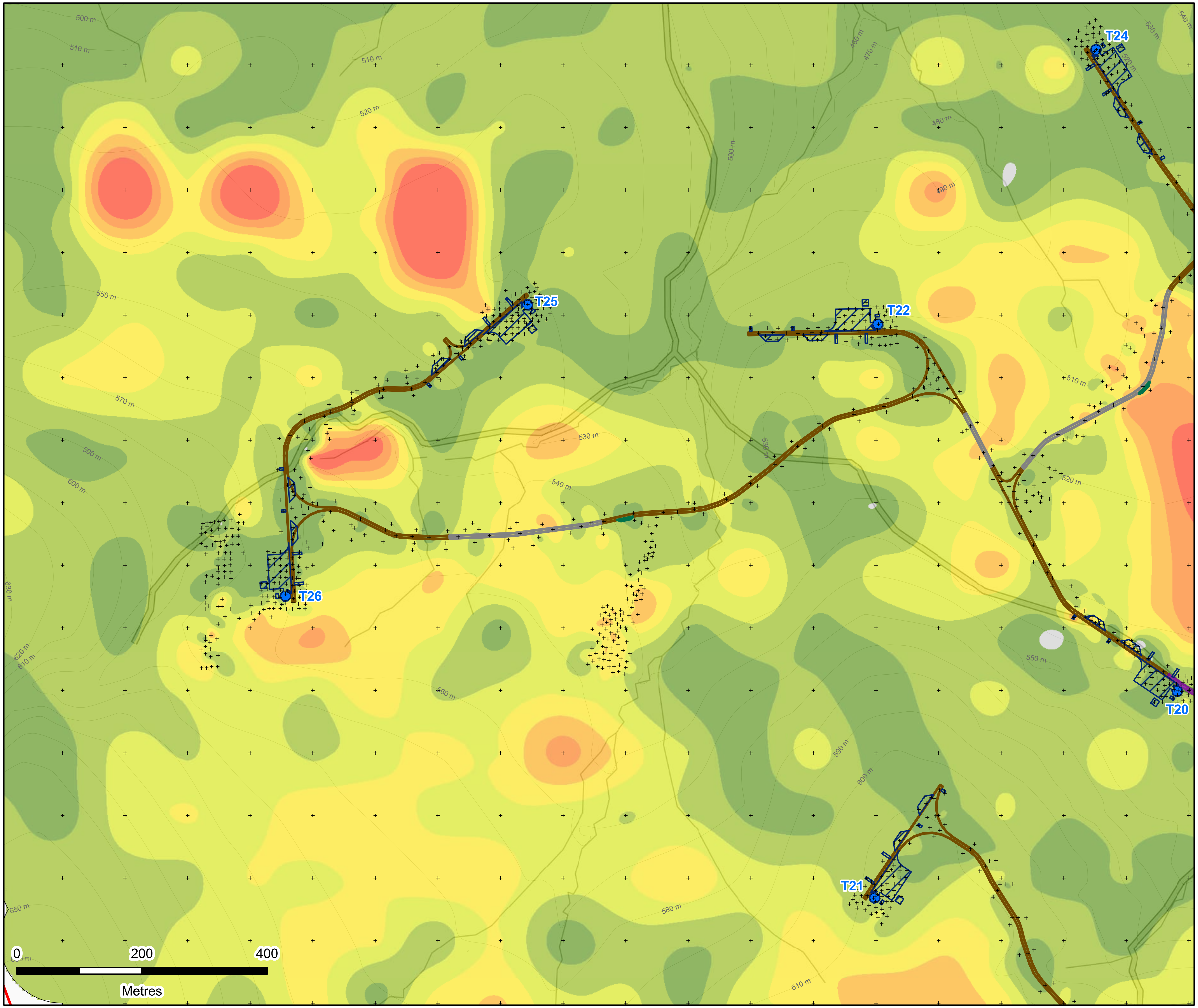

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FIGURE 9.1.6G

PEAT DEPTH

- 🟥 Site Boundary
- ● Proposed Turbine Location
- ▨ Proposed Hardstanding
- 🟩 Proposed Passing Place
- ⬜ Proposed Floated Track
- 🟫 Proposed Site Track
- 🟪 Existing Track to be Upgraded
- + Peat Probe

Peat Depth (m)

- ⬜ 0
- 🟩 0 - 0.5
- 🟩 0.5 - 1
- 🟨 1 - 1.5
- 🟨 1.5 - 2
- 🟧 2 - 2.5
- 🟧 2.5 - 3
- 🟥 > 3

LAYOUT DWG	T-LAYOUT NO.
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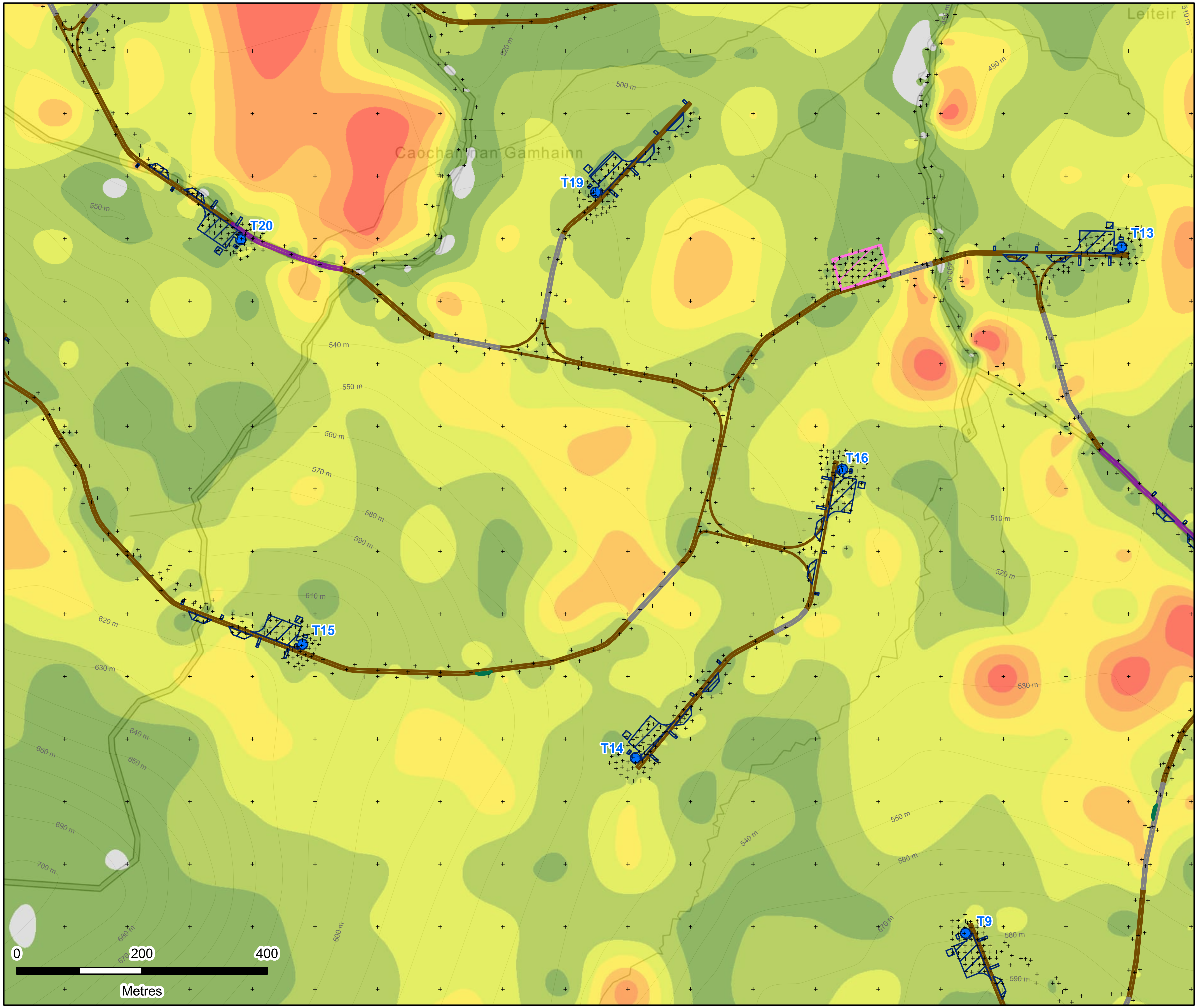

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FIGURE 9.1.6H

PEAT DEPTH

🟥	Site Boundary
●	Proposed Turbine Location
▨	Proposed Hardstanding
▨	Proposed Temporary Construction Compound
🟩	Proposed Passing Place
⬜	Proposed Floated Track
🟫	Proposed Site Track
🟪	Existing Track to be Upgraded
+	Peat Probe

Peat Depth (m)

⬜	0
🟩	0 - 0.5
🟩	0.5 - 1
🟨	1 - 1.5
🟨	1.5 - 2
🟧	2 - 2.5
🟧	2.5 - 3
🟥	> 3

LAYOUT DWG NA

T-LAYOUT NO. PSCOCLU041

DRAWING NUMBER
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SCALE - 1:6,000 @ A3

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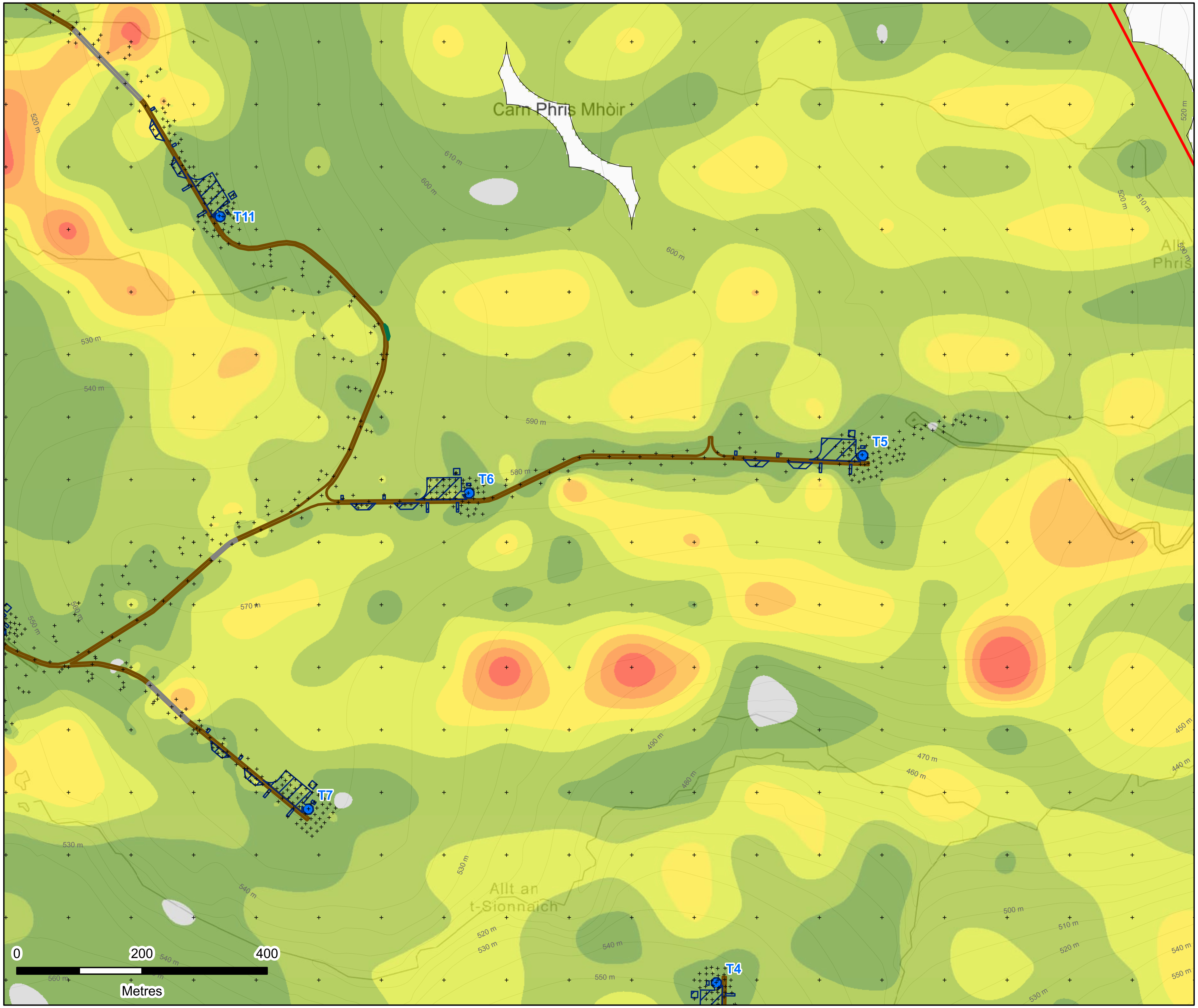

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FIGURE 9.1.6I

PEAT DEPTH

- ▭ Site Boundary
- ● Proposed Turbine Location
- ▨ Proposed Hardstanding
- ▭ Proposed Passing Place
- ▭ Proposed Floated Track
- ▭ Proposed Site Track
- \+ Peat Probe

Peat Depth (m)

- ■ 0
- ■ 0 - 0.5
- ■ 0.5 - 1
- ■ 1 - 1.5
- ■ 1.5 - 2
- ■ 2 - 2.5
- ■ 2.5 - 3
- ■ > 3

LAYOUT DWG NA

T-LAYOUT NO. PSCOCLU041

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