

Annex O - Peat Slide Risk Assessment (PSRA)

September 2022





**AN SUIDHE SUBSTATION
ENVIRONMENTAL APPRAISAL**

ANNEX O

PEAT LANDSLIDE HAZARD AND RISK ASSESSMENT

JULY 2022



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1 INTRODUCTION

1.1 Background

Arcus Consultancy Services Ltd (Arcus) was commissioned by ERM on behalf of SSEN Transmission Ltd (the Applicant) to carry out a Peat Landslide Hazard Risk Assessment (PLHRA) to support an Environmental Assessment (EA) for a new 275 kV electricity substation and overhead line (OHL) Tie-Ins (hereby known as 'the Project') in the vicinity of the existing An Suidhe substation, located at National Grid Ref. 204861, 705524.

The new substation and accompanying infrastructure aspects (hereby known as the Proposed Development) will be subject to Town and Country Planning, while the OHL Tie-Ins and accompanying towers (hereby known as the Associated Development) will be submitted for Section 37 consent. The Site Layout Plan is shown on **Figure 1** in **Appendix A**.

It should be noted that the Project's construction schedules will be aligned. Therefore, peat excavation and re-use will be considered within the wider scope of the Project.

This PLHRA has been prepared to inform Argyll & Bute Council (ABC) and statutory consultees of the prevalence of peat across the Proposed Development and Associated Development as well as highlighting any potential risk of peat slide.

This PLHRA has been undertaken to Scottish Government Guidance 'Proposed electricity generation developments: peat landslide hazard best practice guide'¹.

The PLHRA is accompanied by the following appendices:

- Appendix A: Figures;
- Appendix B: Site Photographs;
- Appendix C: Hazard Rank Calculations; and
- Appendix D: Peat Coring Records

1.2 Scope and Purpose

The scope of this PLHRA is to:

- Review available desk-based information on the Site;
- Undertake a site walkover survey and peat probe surveys to characterise the prevailing ground conditions and identify existing or potential peat instability;
- Report on the findings of the survey and assess the potential instability risk and estimate the hazard from any potential peat slide; and
- Recommend mitigation measures and specific construction methodologies that should be considered during the construction period, if required.

This PLHRA provides factual information on the peat survey results relating to the Proposed Development and Associated Development. The desk-based information and site surveys have been utilised to assess the potential risk of any peat slide. The methodology adopted, and details on the assessment, are outlined in **Sections 3, 4** and **5** of this PLHRA. The assessment has been undertaken in accordance with Scottish Government Guidance in assessing the likelihood, and consequence, of peat slide.

¹ Scottish Government (2017) Proposed electricity generation developments: peat landslide hazard best practice guide [Proposed electricity generation developments: peat landslide hazard best practice guide - gov.scot \(www.gov.scot\)](https://www.gov.scot/publications/proposed-electricity-generation-developments-peat-landslide-hazard-best-practice-guide/pages/16/05/2022/) (Accessed 16/05/2022)

1.3 Project team

Team Member	Job Title	Qualifications	No. Years Experience
Gregor Hirst	Senior Engineer	BSc (Hons)	6 Years
David Ballentyne	Principal Engineer	BSc (Hons)	18 Years
Tomos Ap Tomos	Technical Director	BEng (Hons) MCIHT	25 Years

This assessment was undertaken by Gregor Hirst (BSc Hons), a Geo-Environmental Engineer of 6 years, and was supported by David Ballentyne a Geo-Environmental Civil Engineer with for over 18 years of experience in ground condition assessment. This Chapter has been technically reviewed by Tomos Ap Tomos, Technical Director of Engineering.

2 SITE INFORMATION AND DESK STUDY

2.1 Site Description and Topography

The land which the Project occupies (the Site) is located approximately 5 km south west of Inveraray covering an area of approximately 42 hectares (ha). The Site is located within the administrative boundary of ABC. The Site extends north east to south west, making use of the existing access track to An Suidhe Substation which connects to the A83, approximately 6.45 km south west of Inveraray.

The topography of the Site and immediate vicinity is relatively complex. The elevation of the Site approximately ranges from 190 metres (m) Above Ordnance Survey Datum (AOD) and falls to around 160 m AOD towards the north eastern boundary of the Site. There is one notable hilltop at the centre of the Site named Tom nam-Buachaillean.

2.2 Site Walkover

The purpose of the desk study and site visit was to gain a thorough understanding of the condition of the Site including topography, geology, existing peat instability and hydrology. The outcome of this stage of the study was to determine which areas required detailed intrusive survey (by peat probing) and ultimately provide data for the assessment of PLHRA.

Aerial and satellite photography was reviewed ahead of a number of site visits, undertaken as part of the overall EA process between November 2021 and February 2022. The Site was examined for evidence of peatlands, presence of landslip and localised haggling. Geological mapping and details of proposed infrastructure were pre-loaded to a handheld device for reference during the site walkover. Following a review of these in parallel with the initial site walkover, the desk study aimed to identify and or verify the following:

- The general condition of peat deposits;
- Evidence of any previous peat instability;
- The presence of low lying wet/peat lands; and
- Watercourses and other potential receptors.

2.2.1 Site Conditions

The Project is located in an area of commercial forestry at varying stages of development. The majority of the Proposed Development is within a deforested area where long grasses and shrubs now dominate in hummocky ground. A strip of mature forestry is present within the south eastern area of the Proposed Development.

The majority of the Associated Development is also in deforested areas other than in the southern area where mature forestry is present, with the exception of the extreme south west which is also deforested. Evidence of artificial drainage associated with the forestry plantations was observed and may have resulted in the dewatering of any peat present in these areas of the Site.

Neither mining or quarry activities are known to have taken place at the Site.

The Geomorphology Map is presented as **Figure 4 in Appendix A**, while site photographs taken during the site walkover are included in **Appendix B**.

2.3 Published Geology

2.3.1 Superficial Soils

Published British Geological Survey (BGS)² data information on superficial soils indicates that superficial soils are not present across a majority of the Site. Where superficial deposits are recorded, they comprise glacial deposits of Till within the northern area of the Site, in the location of the proposed substation and temporary construction compound.

Figure 2 illustrates the 'Superficial Soils' map included in **Appendix A**.

2.3.2 Solid Geology

Published BGS mapping information on solid geology indicates the majority of the Site to be underlain by a mix of Semipelite and Metagabbro rock. A metamorphic bedrock, which was formerly sedimentary belonging to the Ardrishaig Formation is present in the northern area of the Site, in close proximity to the proposed substation and Temporary Works Area (TWA). Metamorphic bedrock belonging to the Dalradian Supergroup comprising Metagabbro and Metamicrogabbro is present throughout the central area of the Site, in close proximity to the proposed tower infrastructure. Large bands of igneous intrusions (late Silurian to early Devonian) and minor igneous intrusions of the Mull Dyke Swarm (Palaeogene) are also present within the Site.

Figure 3 illustrates the 'Solid Geology' included in **Appendix A**.

Published BGS Geosure mapping³ indicates that no faulting exists on-site with the nearest linear feature recorded approximately 1.5 km to the north west of the infrastructure, running in a south west- north east orientation.

2.4 Hydrology and Hydrogeology

The groundwater units underlying the Site are identified by Scotland's Environment mapping service as the Oban and Kintyre body⁴. These units have an overall SEPA classification of 'Good', with a low productivity in which groundwater "flow is virtually all through fractures and other discontinuities".

Based on SEPA mapping⁵, the Project is located within the sub-catchments of Allt Tom a' Challtuinne to the north west and Allt Garbh to the south, part of the wider catchment of the Douglas Water. The Douglas Water is classified under the Water Framework Directive (WFD) as Poor (SEPA ID 10226). The Douglas Water flows from the north and passes the eastern aspect of the Proposed Development before flowing south-east and discharging into Loch Fyne. Several unnamed watercourses drain across the Project area and flow north east and east into Douglas Water. In the south, several unnamed watercourses flow south from the Development area across the existing access track and A83 road into the Allt Garbh. Allt Garbh then flows north east before intersecting with Douglas Water.

Figure 4, illustrating the Geomorphology of the Site is included in **Appendix A**.

2.5 Historical Landslip and Geomorphology

No historical landslides are recorded on the site or in the surrounding area using the online BGS GeoIndex⁶

² BGS (2019): <http://mapapps.bgs.ac.uk/geologyofbritain/home.html> (Accessed 17/05/22)

³ BGS (2019): <https://mapapps2.bgs.ac.uk/geoindex/home.html> (Accessed 17/05/22)

⁴ SEPA (undated) Groundwater classification [Online] Available at: <https://map.environment.gov.scot/sewebmap/> (Accessed: 17/05/22)

⁵ SEPA (2014) Water Environment Hub [online] Available at <https://www.sepa.org.uk/data-visualisation/water-environment-hub/> (Accessed 17/05/22)

⁶ [GeoIndex - British Geological Survey \(bgs.ac.uk\)](https://www.bgs.ac.uk/geoindex/) (Accessed 17/05/22)

No evidence of historic peat haggling or localised slippage was noted during the Site walkover and topsoil, where undisturbed generally appeared to be in good condition. Extensive forestry plantations are present across the Site, the majority of which have been subject to felling and it is possible that properties of any peat deposits may have been altered due to these historical activities. Nonetheless, the possibility of instability within peat soils cannot be discounted, especially where there are significant topographic variances and the presence of watercourses.

3 SITE SURVEYS AND RESULTS

3.1 Investigations

Preliminary peat probing was undertaken as part of the initial site optioneering, which was superseded by phases of detailed peat probing focussing on the proposed site infrastructure.

Peat depths have been determined within areas of proposed infrastructure through peat probe surveys undertaken as recommended in the NatureScot (formerly Scottish Natural Heritage (SNH)), Scottish Government and James Hutton Institute guidance for investigating peat. The survey was initiated to inform the EA and design work while supporting the PLHRA. The survey comprised of the following:

- Infrastructure focussed probing comprising 50 m centres along OHL with perpendicular probes between 10 m and 25 m either side of line;
- 10 m x 10 m grid across proposed substation footprint; and
- 10 m x 10 m grid covering an area of 50 m² at proposed towers.

Peat probing surveys were undertaken across a series of visits between November 2021 and February 2022. The probe positions for these visits were focussed on the Proposed infrastructure including the substation, permanent access tracks and other 'Temporary Works Areas'. Peat depths were measured along the proposed access tracks at 50 m centres with offsets of 25 m on either side of the centre line where possible, while an intense 10 m grid provided detailed peat information at the proposed substation and a 25 m grid was adopted to cover the TWA. Furthermore, regarding the Associated Development six tower positions were covered at 10 m spacing to a 25 – 30 m distance in all directions to allow for potential micro-siting and proposed temporary access tracks were covered in a similar methodology to the permanent tracks.

It should be acknowledged that natural variations in peat depth/thickness could occur between probe positions, although areas of infrastructure have undergone intensely spaced probing meaning that variations are less likely.

3.2 Summary of Peat Depths

Throughout the peat surveys a total of 470 probes were progressed with over 95% of probes recording peat depths of 1.0 m or less. Thick peat (where the depth was greater than >1.0 m) was recorded at 4.7% of probe locations. The majority of thick peat was recorded at depths between 1.0 m – 2.0 m with only eight probes recording depths in excess of 2.0 m.

Proposed infrastructure within the Associated Development, including a tower and a section of temporary access track are located in the vicinity of the deep peat near the periphery of the forestry in the west of the Site. Micro-siting may be required to re-locate it to an area of shallower peat, if possible.

The Proposed Development infrastructure including proposed substation and temporary works area are located in a deforested area (spruce plantation) with overgrown grasses and discarded wood cutting recorded during the walkover. The area has a very shallow peat profile, with only one probe recording a peat depth greater than 1.0 m on the southern edge of the substation, while all probes in the TWA recorded peat depths less than 1.0 m.

The Permanent Access Track (Proposed Development) linking the substation to the existing track generally lies on shallow peat, however one reading of 1.4 m was recorded on the centre line and may require some micro-siting to avoid. The Permanent Access Tracks in the east connecting two towers to the existing track were recorded to be in areas of peat less than 0.5 m.

Table 1 summarises the recorded peat depths.

Table 1: Peat Depth Summary

Peat Depth Range (m)	No of peat probes	Percentage of Total (%)
0.00 - 0.50	408	86.8
0.51 - 1.00	40	8.5
1.01 - 1.50	7	1.5
1.51 - 2.00	7	1.5
2.01 - 2.50	5	1.1
2.51 - 3.00	2	<1.0
3.01 – 3.50	0	0.0
3.51 – 4.00	1	<1.0

The peat probe locations and depths are shown on **Figure 5** appended with this PLHRA, and detailed probing records are included in **Appendix C**. The Interpolated Peat Depths were determined using the Inverse Distance Weighting (IDW) method of interpolation to a resolution of 5 m and are illustrated on **Figure 6**.

3.3 Peat Cores

Peat cores were also obtained from selected areas of the Site where peat probing had identified areas of deep peat, in order to further characterise the peatland. The methodology in which the peat coring was undertaken was guided by the Peatland Survey (2017) *Guidance on Developments on Peatland*⁷, commissioned by the Scottish Government, Scottish National Heritage (now NatureScot) and SEPA. An outline of the methodology along with photographs and characterisation of the peat cores are presented in the Peat Coring Records in **Appendix D**.

Humification of peat is determined using the Von Post scale which indicates the degree to which peat has undergone humification or, more correctly, a type of decomposition which includes breakdown under anaerobic conditions. The Von Post Scale (H) ranges from 1 to 10, the higher the number the higher the degree of humification.

The core samples were obtained to depths ranging from 1.0 m to 3.0 m and humification values ranged between 4 and 8, generally becoming more humified with depth, as presented in the Peat Coring Records along with definitions of the Von Post values in **Appendix D**.

⁷ Scottish Government, Scottish Natural Heritage, SEPA (2017) Peatland Survey. *Guidance on Developments on Peatland*.

4 GUIDANCE AND METHODOLOGY

4.1 Overview of Guidance and Peat Failure Mechanisms

4.1.1 Peat Depth and Slope

The Scottish Government guidance divides peat instability into two categories: 'peat slides' and 'bog bursts'. The guidance states that peat slides have a greater risk of occurrence in areas where:

- Peat is encountered at or near to ground surface level;
- The thicknesses are recorded in the region of 2.0 m (above which, in general terms, peat instability would increase with peat thickness); and
- The slope gradients are steep (between 5° and 15°).

Bog bursts are considered to have a greater risk of occurrence in areas where:

- Peat depth is greater than 1.5 m; and
- Slope gradients are shallow (between 2° and 10°).

It should be noted however that peat instability events, although uncommon, can occur out with these limits. Reports of bog bursts are generally restricted to the Republic and Northern Ireland.

Further to the general guidance above, in relation to peat depth, it is considered that the extent and depth of peat is controlled to a degree by rainfall and elevation, giving rise to three common types of peat (Boylan et al. 2008⁸):

- Upland Blanket Bog: Blanket bogs are typically about 3 m thick however, they can be up to 5 m thick. Generally thinning at greater elevations;
- Raised Bog: Raised bogs generally tend to be 3-12 m thick, averaging 7 m with their growth occurring above the water table; and
- Lowland Blanket Bog: Much the same as the upland version; however, they form around sea level in areas of very high rainfall.

Generally, the potential for peat instability increases with peat depth, however other instability indicators need to be considered, namely slope and substrate.

4.1.2 Substrate

Peat slide failures tend to occur at the interface of the peat and underlying substrate therefore, understanding the nature of the underlying substrate can provide a key factor when considering the risk stability.

Using the peat probe refusal, an estimation of the underlying materials can be determined based on:

- Gradual refusal – Clay;
- Crunching/Gritty – Weathered Rock/Sand and Gravel; or
- Abrupt Refusal/Hard – Rock.

Where sand and/or gravel is recorded, the interface is considered to be the best-case scenario with the highest friction value.

Where clay is recorded, the upper horizons of the clay are typically softened through poor drainage in this soil group with low shear strengths expected. While rock substrate provides a high strength, the surface being smooth can lead to a weak interface, with similar risk to that of a clay substrate.

⁸ Boylan et al (2008) Peat Slope Failure in Ireland

The presence of slip material, or evidence of peat instability would represent the worst-case scenario for the assessment of substrate.

The substrate parameters are included in the Hazard and Exposure Assessment in **Section 5** of this PLHRA.

4.1.3 Other Considerations

Preparatory factors which effect the stability of peat slopes in the short to medium-term include:

- Loss of surface vegetation (deforestation);
- Changes in sub-surface hydrology;
- Increase in the mass of peat through accumulation, increase in water content and growth of tree planting; or
- Reduction in shear strength of peat or substrate due to chemical or physical weathering, progressive creep and tension cracking.

Triggering factors which can have immediate effect on peat stability and act on susceptible slopes include:

- Intensive rainfall or snow melt causing pressures along existing or potential peat/substrate interfaces;
- Snow melt;
- Alterations to drainage patterns, both surface and sub-surface;
- Peat extraction at the toe of the slope reducing the support of the upslope material;
- Peat loading (commonly due to stockpiling) causing an increase in shear stress; and
- Earthquakes or rapid ground accelerations such as due to blasting or mechanical movement.

Consideration of peat stability should form an integral part of development design. While peat does not wholly provide a development constraint, areas of deep peat or peat deposits on steep slope should be either avoided through design and micro-siting; or mitigation measures should be designed to avoid instability and movement.

4.2 Methodology

Despite The Proposed Development being an application under the Town and Country Planning (Scotland) Act 1997⁹ and the Associated Development is to be submitted for Section 37 consent, the PLHRA has been carried out in accordance with the Energy Consents Unit, Scottish Government guidance of 2017 titled "Peat Landslide Hazard and Risk Assessments - Best Practice Guide for Proposed Electricity Generation Developments"¹⁰.

In June 2014, Scottish Planning Policy¹¹ (SPP) and National Planning Framework (NPF3)¹² were published. In relation to peat and the assessment of effects on resource, NPF3 references Scotland's National Peatland Plan¹³. These policy, framework and guidance documents are considered in this PLHRA. The PLHRA undertaken is based on:

- Desk based assessment;

⁹ Scottish Government (1997) Town and Country Planning (Scotland) Act 1997 [Online] Available at: <http://www.legislation.gov.uk/ukpga/1997/8/contents> (Accessed 17/05/22)

¹⁰ Scottish Government (2017) Peat Landslide Hazard and Risk Assessment: Best Practice Guide for Proposed Electricity Generation Development [Online] Available at: <https://www.gov.scot/Publications/2017/04/8868> (Accessed 17/05/22)

¹¹ Scottish Government (2014) Scottish Planning Policy [Online] Available at: <http://www.scotland.gov.uk/Topics/Built-Environment/planning/Policy> (Accessed 17/05/22)

¹² Scottish Government (2014) National Planning Framework 3 [Online] Available at: <http://scotland.gov.uk/Resource/0045/00453683.pdf> (Accessed 17/05/22)

¹³ SNH (2015) Scotland's National Peatland Plan [Online] Available at: <https://www.nature.scot/climate-change/taking-action/carbon-management/restoring-scotlands-peatlands/scotlands-national-peatland-plan> (Accessed 17/05/22)

- Site Walkover;
- An initial Phase 1 Probing scheme;
- Phase 2 Probing comprising infrastructure specific probing; and
- A hazard and risk ranking assessment.

The area of the Site subject to assessment was determined by the emerging development layout which considered both anticipated peat deposits as well as other physical and environmental constraints.

4.2.1 Development of Hazard Rank

The early stages of the PLHRA including the desk study, site visit and peat probing were carried out in parallel with the assessment of wider constraints to inform the layout of the Project. Following identification of peat depths within the Site, the assessment has determined the potential effects on the peat resource from construction activities which would include:

- Construction of tracks;
- Excavation of infrastructure bases;
- Foundation construction;
- Construction of hardstanding; and
- Temporary storage of peat and soils.

An assessment of the peat probing data and a review against desk study information was undertaken and a hazard rank was calculated for different zones across the Site reflecting risk of peat instability/constraint to construction.

Where practical, the Project design would be progressed to avoid areas of a risk score above 'low'. Where this has would not be achievable, areas affected would be discussed in both the EA as having significant effect, with relative mitigation measures proposed to reduce this, and recorded on a risk register which sets out specific mitigation measures which are considered necessary to reduce the risk of inducing instability.

Details of the hazard and risk ranking assessment is included in **Sections 5** and **6** of this PLHRA.

5 HAZARD AND EXPOSURE ASSESSMENT

5.1 Background

A 'Hazard Ranking' system has been applied across the Site based on the analysis of risk of peat slide as outlined in the Scottish Government guidance. This is applied on the principle:

$$\text{Hazard Ranking} = \text{Hazard} \times \text{Exposure}$$

Where 'Hazard' represents the likelihood of any peat slide event occurring and 'Exposure' being the impact or consequences that a peat slide may have on sensitive receptors that exist on and around the Site.

5.2 Methodology

The determination of Hazard and Exposure values is based on a number of variables which impact the likelihood of a peat slide (the Hazard), and the relative importance of these variables specific to the Site.

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 Hazard and Exposure is determined on a site-by-site basis. The particular system adopted for the Development PLHRA assessment is outlined in the following sub sections.

5.3 Hazard Assessment

The potential for a peat slide to occur during the construction of a electricity substation and OHL Tie-Ins depends on several factors, the importance of which can vary by site. The factors requiring considerations would typically include:

- Peat depth;
- Slope gradient;
- Substrate material;
- Evidence of instability or potential instability;
- Vegetation cover; and
- Hydrology.

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 Slope Gradient has been established using a Digital Terrain Model (DTM) to a resolution of 5 m which is illustrated in **Figure 7**. For the Proposed Development and Associated Development, the substrate material is also considered a relevant factor in relation to slide.

Vegetation cover and evidence of instability or potential instability were assessed during site surveys and, alongside satellite photography, informed the Geomorphology Map presented in **Figure 4**. This information was also considered during the adoption of hazard zones across the Site, which are presented in **Figure 9**: Hazard Rank Zonation Plan.

Due to the nature of the assessment and number of data points used to establish hazard ranking, gathering hydrological data at each probe point through the use of groundwater boreholes and a subsequent monitoring period is considered impractical. Therefore, an assumption on groundwater levels has been adopted for the assessment that 90% of the

peat at each probe location is below the water table. As such, it is assumed that the water table across the Site is relatively high.

5.4 Hazard Rating

When several factors may impact on the Hazard potential, a relative ranking process is applied attributing different weighting to each factor as shown below.

Table 4: Coefficients for Slope Gradients

Slope Angle (degrees)	Slope Angle Coefficients
Slope < 2°	1
2° < Slope < 4°	2
4° < Slope < 8°	4
8° < Slope < 15°	6
Slope >15°	8

Table 5: Coefficients for Peat Thickness and ground conditions

Peat Thickness	Ground Conditions Coefficients
Peaty or organic soil (<0.5 m)	1
Thin Peat (0.5 – 1.0 m)	2
Deep Peat (>1.0 m)	3*
Deep Peat (>3.0 m)	8

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

Table 6: Coefficients for Substrate

Substrate Material	Substrate Coefficients
Sand/gravel	1
Rock	1.5
Clay	2
Not proven	2
Slip material (Existing materials)	5

The Hazard Rating Coefficient for a particular location is calculated using the following equation:

$$\text{Hazard Rating Coefficient} = \text{Slope Gradient} \times \text{Peat Thickness} \times \text{Substrate}$$

From the Hazard Rating Coefficient, the risk to stability can be ranked as set out in Table 7.

Table 7: Hazard Rating

Hazard Rating Co-efficient	Potential Stability Risk (Pre-Mitigation)
<5	Negligible
5 to 15	Low
16 to 30	Medium
31 to 50	High
> 50	Very High

5.5 Peat Stability Assessment

The likelihood of a particular slope or hillside failing can be expressed as a Factor of Safety. For any potential failure surface, there is a balance between the weight of the potential landslide (driving force or shear force) and the inherent strength of the soil or rock within the hillside (shear resistance).

The guidance states that the 'Infinite Slope' method of analysis, after Skempton and DeLory (1957), is the most well established and commonly applied method for the assessment of peat slope stability. The stability of a slope can be assessed by calculating the factor of safety F , which is the ratio of the sum of resisting forces (shear strength) and the sum of the destabilising forces (shear stress):

$$F = \frac{c' + (\gamma - m\gamma_w)z \cos^2 \beta \tan \phi'}{\gamma z \sin \beta \cos \beta}$$

Where c' is the effective cohesion, γ is the bulk unit weight of saturated peat, γ_w is the unit weight of water, m is the height of the water table as a fraction of the peat depth, z is the peat depth in the direction of normal stress, β is the angle of the slope to the horizontal and ϕ' is the effective angle of internal friction. Values of $F < 1$ indicate a slope would have undergone failure under the conditions modelled; values of $F > 1$ suggest conditions of stability.

In the absence of any historical hydrological monitoring, an assumption on groundwater levels has been adopted for the assessment, that 90% of the peat column at each probe location is below the water table, an overall conservative approach. While the assessment considers the recorded data at each of the peat probes to establish hazard ranking for the purposes of the peat stability analysis, groundwater depth is conservatively assumed to be within close proximity of the surface, based on the understanding of peat and its hydrological properties that it can consist of up to 90% water by volume.

Assumed geotechnical parameters have been utilised in the formula to inform the stability assessment, based on literature values to inform the stability analysis, as included in **Table 8**.

Table 8: Literature for Geotechnical Parameters of Peat

Reference	Effective Cohesion C' (kPa)	Effective Angle of Friction ϕ (°)	Unit Weight γ (kN/m ³)	Comments
Hanrahan et al (1967) ¹⁴	5.5 – 6.1	36.6 - 43.5	-	Remoulded H4 Sphagnum peat
Hollingshead and Raymond (1972) ¹⁵	4.0	34	-	-
Hollingshead and Raymond (1972)	2.4 – 4.7	27.1 – 35.4	-	Sphagnum peat (H3, mainly fibrous)
Carling (1986) ¹⁶	6.52	0	10	-

¹⁴ Hanrahan et al (1967) - Hanrahan, E.T., Dunne, J.M., and Sodha, V.G. 1967. Shear strength of peat. Proceedings Geotechnical Conference, Oslo, Vol. 1, pp. 193–198.

¹⁵ Hollingshead and Raymond (1972) - Hollingshead, G.W., and Raymond, G.P. 1972. Field loading tests on Muskeg, Canadian Geotechnical Journal, 9(3): 278–289.

¹⁶ Carling (1986) - Peat slides in Teesdale and Weardale, northern pennines, July 1983: Description and failure mechanisms

Kirk (2001) ¹⁷	2.7 – 8.2	26.1 – 30.4		Ombrotrophic blanket peat
Warburton et al (2003) ¹⁸	5.0	23	9.68	Basal Peat
Warburton et al (2003)	8.74	21.6	9.68	Fibrous Peat
Dykes and Kirk (2006)	3.2	30.4	9.61	Acrotelm
Dykes and Kirk (2006)	4.0	28.8	9.71	Catotelm

C' – effective cohesion (kPa), typically ranging from 2.5 to 8.5 therefore 5.0 has been adopted for the purposes of the assessment.

ϕ – effective angle of friction ($^{\circ}$), typically ranging from 21.6 to 43.5 therefore 29.6 has been adopted for the purposes of the assessment.

γ – unit weight (kN/m²), typically ranging from 9.61 to 10, therefore 10 has been adopted for the purposes of the assessment.

In accordance with the best practice method, F values of <1.0 indicate slopes that would experience failure under the modelled conditions and as such are considered areas of high risk. However, Boylan et al (2008) indicate that a relatively high value of F=1.4 should be used to identify slopes with the potential for instability. Adopting this approach, 'high' risk areas are indicated where F is <1.0, 'medium' risk areas are indicated as 1.01 to 1.50 and >1.5 are 'low' risk.

Using digital terrain modelling and GPS co-ordinates of each peat probe, a Factor of Safety (FoS) has been calculated for each probe locations which has been interpolated through ArcGIS Spatial Analyst tools. In this instance, the Inverse Distance Weighting (IDW) method of interpolation was used with a resolution of 5 m. The FoS Assessment provides a sense check of the ranking based system, providing an absolute approach to the 'Factor of Safety Plan' is shown on **Figure 8**.

The results of the FoS calculations indicate that the lowest value point at the Site is 1.67 and therefore all the points are 'low' risk in regards to FoS.

5.6 Exposure Assessment

The main Exposure receptors identified within the Site and surrounding area which could potentially be affected in the event of a peat slide were important habitats (blanket bog), watercourses and associated tributaries.

The impact of a peat slide on receptors can be assessed on a relative scale based on the potential for loss of habitat, a historical feature or disruption/danger to the public. To effectively assess the impact, the assessment of Exposure effect must also consider the distance between the hazard and the receptor, and the relative elevation between the two.

5.7 Exposure Rating

Similar to the Hazard Rating, the Exposure Ratings were determined using relative ranking process by attributing the different weighting systems to each factor as shown below:

Table 9: Coefficients for Receptor Type

Receptor	Receptor Coefficients
----------	-----------------------

¹⁷ Kirk (2001) - Initiation of a multiple peat slide on Cullcagh Mountain, Northern Ireland

¹⁸ Warburton et al (2003) - Anatomy of a Pennine peat slide, Northern England

Road, path or track	3
Minor water feature	6
Site infrastructure	6
Dwelling	8
Major water feature	8
Blanket bog	8

Table 10: Coefficients for Distance from Receptor

Distance from Receptor	Distance Coefficients
> 1 km	1
100 m to 1 km	2
10 m to 100 m	3
<10 m	4

Table 11: Coefficients for Receptor Elevation

Receptor Elevation	Elevation Coefficients
< 10 m	1
10 m to 50 m	2
50 m to 100 m	3
> 100 m	4

The Exposure Rating Coefficient for a particular location is calculated using the following equation:

$$\text{Exposure Rating Coefficient} = \text{Receptor} \times \text{Distance} \times \text{Elevation}$$

From the Exposure Rating Coefficient, the risk to stability can be ranked as set out in **Table 12**.

Table 12: Exposure Rating

Exposure Rating Co-efficient	Potential Stability Risk (Pre-Mitigation)
<6	Very Low
6 to12	Low
13 to 24	High
24 to 30	Very High
>30	Extremely High

5.8 Rating Normalisation

In order to achieve an overall Hazard Ranking in accordance with the Scottish Government Guidance, the Hazard and Exposure Rating Coefficient derived from the coefficient tables are normalised as shown in **Table 13**.

Table 13: Rating Normalisation

Hazard Rating		Exposure Rating	
Current Scale	Normalised Scale	Current Scale	Normalised Scale
< 5 Negligible	1	<6 Very Low	1

Annex O: Peat Landslide Hazard and Risk Assessment
An Suidhe Substation

5 to 15 Low	2	6 to 12 Low	2
15 to 30 Medium	3	13 to 24 High	3
30 to 50 High	4	25 to 30 Very High	4
>50 Very high	5	>30 Extremely High	5

The record of the Hazard Rank Assessment is included in **Appendix C** of this PLHRA.

6 HAZARD RANKING

Having identified the rating coefficients in **Section 5** of this PLHRA, it is possible to categorise areas of the Site with a Hazard Ranking by multiplying the Hazard and Exposure Rating. Hazard Ranking and associated suggested actions matrix are shown in **Tables 14** and **15** below.

Table 14: Hazard Ranking and Suggested Actions

Hazard Ranking		Action Suggested in the Scottish Executive Guidance
17-25	High	Avoid project development at these locations.
11-16	Medium	Project should not proceed unless hazard can be avoided or mitigated at these locations, without significant environmental impact, in order to reduce hazard ranking to low or less
5-10	Low	Project may proceed pending further investigation to refine assessment. Mitigation of hazards maybe required through micro-siting or re-design at these locations.
1-4	Negligible	Project should proceed with monitoring and mitigation of peat landslide hazards at these locations as appropriate.

Table 15: Hazard Ranking Matrix

Hazard Rating	5	Low	Low	Medium	High	High
	4	Negligible	Low	Medium	Medium	High
	3	Negligible	Low	Low	Medium	Medium
	2	Negligible	Negligible	Low	Low	Low
	1	Negligible	Negligible	Negligible	Negligible	Low
	1	2	3	4	5	
	Exposure Rating					

Receptor exposure was assessed for each of the five hazard zones using the approach in **Section 5**. A summary of the Hazard Ranking result for each identified area is summarised in **Table 16** and is presented in **Figure 9** - Hazard Ranking Zonation Plan. The zonation is based on a combination of considerations including calculated hazard result, peat depth, topography, receptors and land uses.

7 SLIDE RISK AND MITIGATION

7.1 General

The PLHRA has shown the Site to be generally of 'negligible' hazard ranking, with an isolated area of 'low' hazard ranking. These hazard rankings are a result of limited peat cover across much of the site leading to negligible hazard across much of the site and just a localised area of deep peat recorded beneath the proposed substation platform which has informed a Low rank area.

No Medium or High risk areas have been identified within the Proposed Development or Associated Development and therefore a significant risk of peat slide is not considered to present based on the Hazard Ranking assessment. Nonetheless, a risk from peat slide may still exist and mitigation measures as outlined in **Section 7.3** of this PLHRA should be applied to minimise any risk.

Where the hazard ranking has been lowered through mitigation measures, the original ranking will remain in the overall hazard zoning plan. It should be acknowledged that the hazard zonation plan is based on the pre-mitigation status.

While specific recommended mitigation in 'low' ranked areas are proposed, other mitigation is embedded in the design. It is also necessary for detailed design and construction of the Proposed Development and Associated Development to be undertaken in a competent and controlled manner.

The embedded mitigation and good practice measures are set out in **Section 7.2** and **Section 7.3** of this PLHRA. It should be noted that the mitigation measures defined are not exclusive and other forms of mitigation may well be required and should be implemented during construction of the Proposed Development and Associated Development.

Table 16: Hazard Ranking

Hazard Area and Infrastructure		Unmitigated Hazard		Mitigated Hazard	
Hazard Area	Infrastructure Affected	Ranking	Key Aspects	Specific Actions	Ranking
H1	Proposed towers and temporary tracks	Negligible	Location and topography: South western section of the Site within the Associated Development. Hydrology: None Peat Depth: 0.0 m - 3.9 m. Generally, <0.5 m Slope Gradient: 0° to <30° Exposure: Proposed infrastructure	Best practice measures in relation to drainage prior to and during construction will be implemented as outlined in Annex J: Water Construction Environmental Management Plan (WCEMP) and management of peat and peaty soils as outlined in Annex N: Outline Peat Management Plan (oPMP) .	Negligible
H2	TWA and permanent tracks	Negligible	Location and topography: Central western sector of the Site spanning the south western area of the Proposed Development and central area of the Associated Development. Hydrology: Allt Tom a'Challtuinne runs through the north western sector of this area, running north east towards Douglas Water	Micro-siting in to areas of thinner peat where required. Best practice measures in relation to drainage prior to and during construction will be implemented as outlined in Annex J: WCEMP and management of peat and peaty soils as outlined in Annex N: oPMP.	Negligible

Annex O: Peat Landslide Hazard and Risk Assessment
An Suidhe Substation

Hazard Area and Infrastructure		Unmitigated Hazard		Mitigated Hazard	
			<p>Peat Depth: 0.0 m - 1.4 m. Generally, <0.5 m</p> <p>Slope Gradient: 0° to <15°</p> <p>Proposed infrastructure and minor watercourse</p>		
H3	TWA, proposed substation and permanent tracks	Low	<p>Location and topography: Central area of the Site spanning both the Proposed Development and Associated Development.</p> <p>Hydrology: Unnamed tributary to Douglas Water runs through this area</p> <p>Peat Depth: 0.0 m - 1.1 m. Generally, <0.5 m</p> <p>Slope Gradient: 0° to <15°</p> <p>Exposure: Proposed infrastructure and minor watercourse</p>	<p>Best practice measures in relation to drainage prior to and during construction will be implemented as outlined in Annex J: WCEMP and management of peat and peaty soils as outlined in Annex N: oPMP.</p> <p>During construction visual inspections and monitoring in areas with the potential for peat slide risk should take place.</p>	Negligible
H4	Proposed substation	Negligible	<p>Location and topography: Northern sector of the Site comprising the north eastern sector of the Proposed Development</p> <p>Hydrology: Allt Tom a'Challtuinne runs through the north western sector of this area, running north east towards Douglas Water</p> <p>Peat Depth: 0.00 m - 0.8 m. Generally, <0.5 m</p>	<p>Best practice measures in relation to drainage prior to and during construction will be implemented as outlined in Annex J: WCEMP and management of peat and peaty soils as outlined in Annex N: oPMP.</p>	Negligible

Hazard Area and Infrastructure		Unmitigated Hazard		Mitigated Hazard	
			<p>Slope Gradient: 0° to <10°</p> <p>Exposure: Proposed infrastructure and minor watercourse</p>		
H5	Proposed towers and proposed permanent tracks	Negligible	<p>Location and topography: Eastern and north eastern site area within the Associated Development.</p> <p>Hydrology: Unnamed tributary to Douglas Water runs through this area</p> <p>Peat Depth: 0.0 m - 0.6 m. Generally, <0.5 m</p> <p>Slope Gradient: 0° to <15°</p> <p>Exposure: Proposed infrastructure and minor watercourse</p>	Best practice measures in relation to drainage prior to and during construction will be implemented as outlined in Annex J: WCEMP and management of peat and peaty soils as outlined in Annex N: oPMP.	Negligible

7.2 Embedded Mitigation

Embedded mitigation includes measures taken during design of the Project to reduce the potential for peat slide risk. In summary the principal measures that have been taken are:

- Locating infrastructure on shallower slopes, where possible; and
- Locating infrastructure on areas of shallow peat (or no peat) where possible.

7.3 Peat Slide Mitigation Recommendations

The following mitigation measures should be adopted post-consent stage and pre-construction to validate the PLHRA and influence the detailed design of the Project, including:

- Ground investigations prior to detailed design, including additional peat depth surveys;
- Update the PLHRA as necessary following detailed ground investigations;
- Identification of areas sensitive to changes in drainage regime prior to detailed design;
- Development of a drainage strategy that will not create areas of concentrated flow and will not affect the current peatland hydrology;
- Design of a Development drainage system for tracks and hardstanding that will require minimal ongoing maintenance during the operation of the substation;
- Inspection and maintenance of the drainage systems during construction and operation;

- Identification of suitable areas for stockpiling material during construction prior to commencement of works; and
- Consideration of specific construction methods appropriate for infrastructure in peat land (i.e., geogrids) as part of design Development.

During the construction stage, toolbox talks should be delivered to site personnel, which should contain but not be limited to the following information:

- Peat slide risks and associated indicators;
- Best practise techniques when working in the peatland environment; and
- Discussion on being careful not to disrupt or disturb the natural drainage on slopes.

8 CONCLUSIONS

This PLHRA has been undertaken for the Project in accordance with best practice, as detailed in **Section 4.2** of this PLHRA. The assessment included a desk study followed by completion of an intensive probing exercise across the proposed infrastructure and surrounding areas at the Proposed Development and Associated Development. The information gathered during this investigation was used to develop a Hazard Ranking across the Site.

The findings of the probing indicate that the vast majority of the Project is underlain by peat less than 0.5 m in thickness, although pockets of deep peat were recorded across the wider site area with depths up to 3.9 m encountered in the south western area.

Based on the scope of the study, the PLHRA has indicated that the majority of the Site is generally of 'negligible' hazard ranking with two areas also highlighted as 'low' hazard ranking. Therefore, a significant risk of peat slide does not exist and it is considered that following the implementation of mitigation measures outlined in **Section 7.3** of this PLHRA, the maximum residual hazard posed to the Development will be 'negligible'.

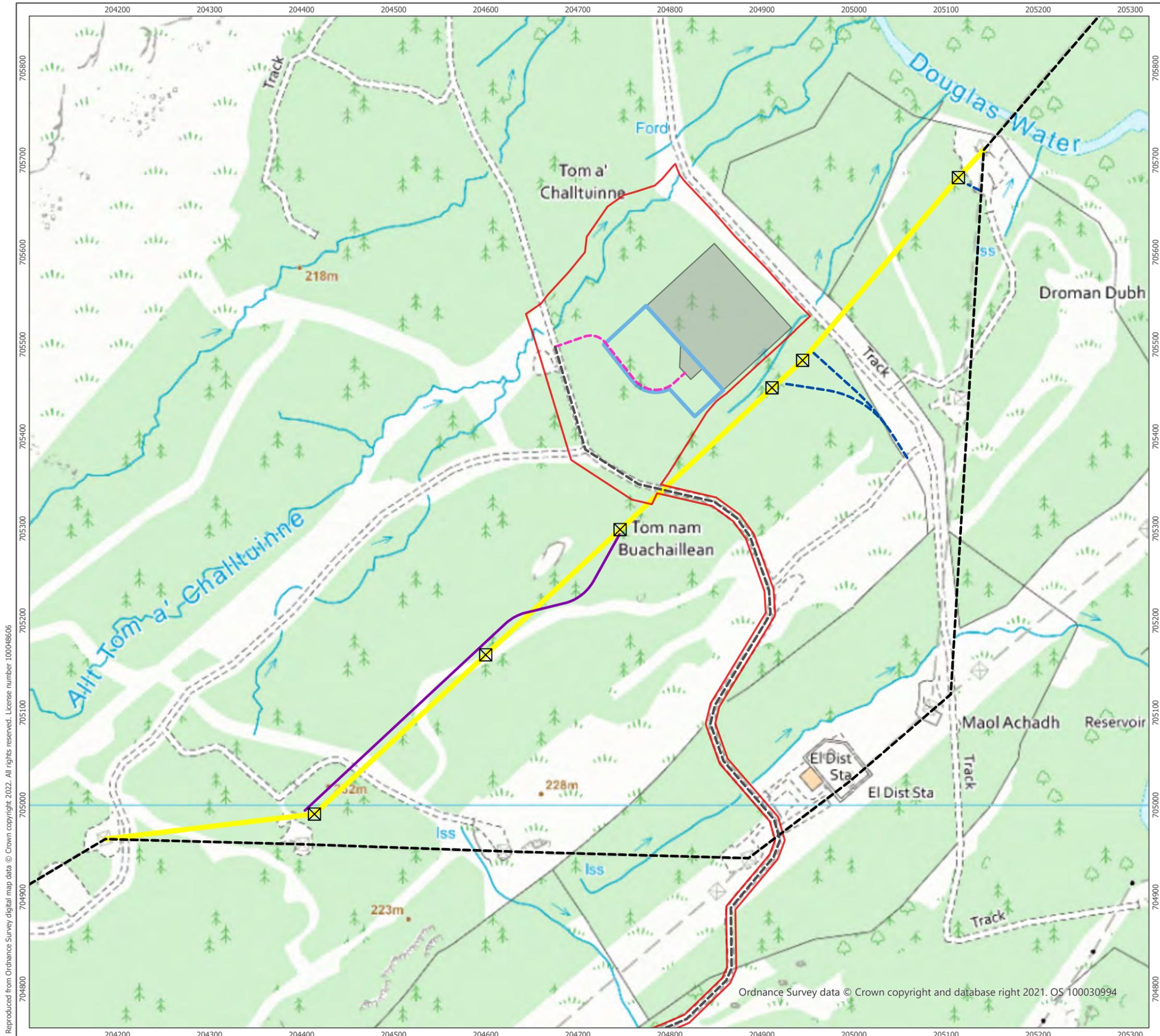
Notwithstanding the findings of the PLHRA, the final design of infrastructure should be carefully sited and micro-siting adopted if required in order to maintain the design objective of avoiding any potential peat slide risk.

9 SOURCES OF INFORMATION

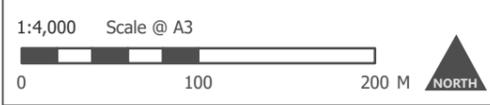
The following sources of information were used as part of the desk study investigations:

- British Geological Survey - Online GeoIndex;
- Ordnance Survey (OS) topographical information;
- Aerial and Satellite photography.
- Soil Survey of Scotland - MacAulay Institute for Soil Research (1984);
- Soil Survey of Scotland - Scottish Peat Surveys (1964);
- Scottish Government - Peat Landslide Hazard and Risk Assessments (2017);
- Scottish Government, Scottish Natural Heritage, SEPA (2017) Peatland Survey, Guidance on Developments on Peatland;
- The Scottish Government - Scotland's Third National Planning Framework (2014);
- The Scottish Government - Scottish Planning Policy (2014);
- Assessments by other technical specialists (specifically hydrology and ecology for data on sensitive receptors); and
- Scotland's Environment Interactive Map.

APPENDIX A - FIGURES



- Existing Inveraray to Crossaig Overhead Line
- Existing Access Track
- Proposed Development**
- ▭ Indicative Town and Country Planning Boundary
- ▭ Proposed Substation Temporary Works Area
- ▭ Proposed Substation Layout
- Proposed Permanent Access Track
- Associated Development**
- Proposed Permanent Access Track
- Proposed Temporary Tracks
- Proposed OHL Alignment
- ⊠ Tower Location



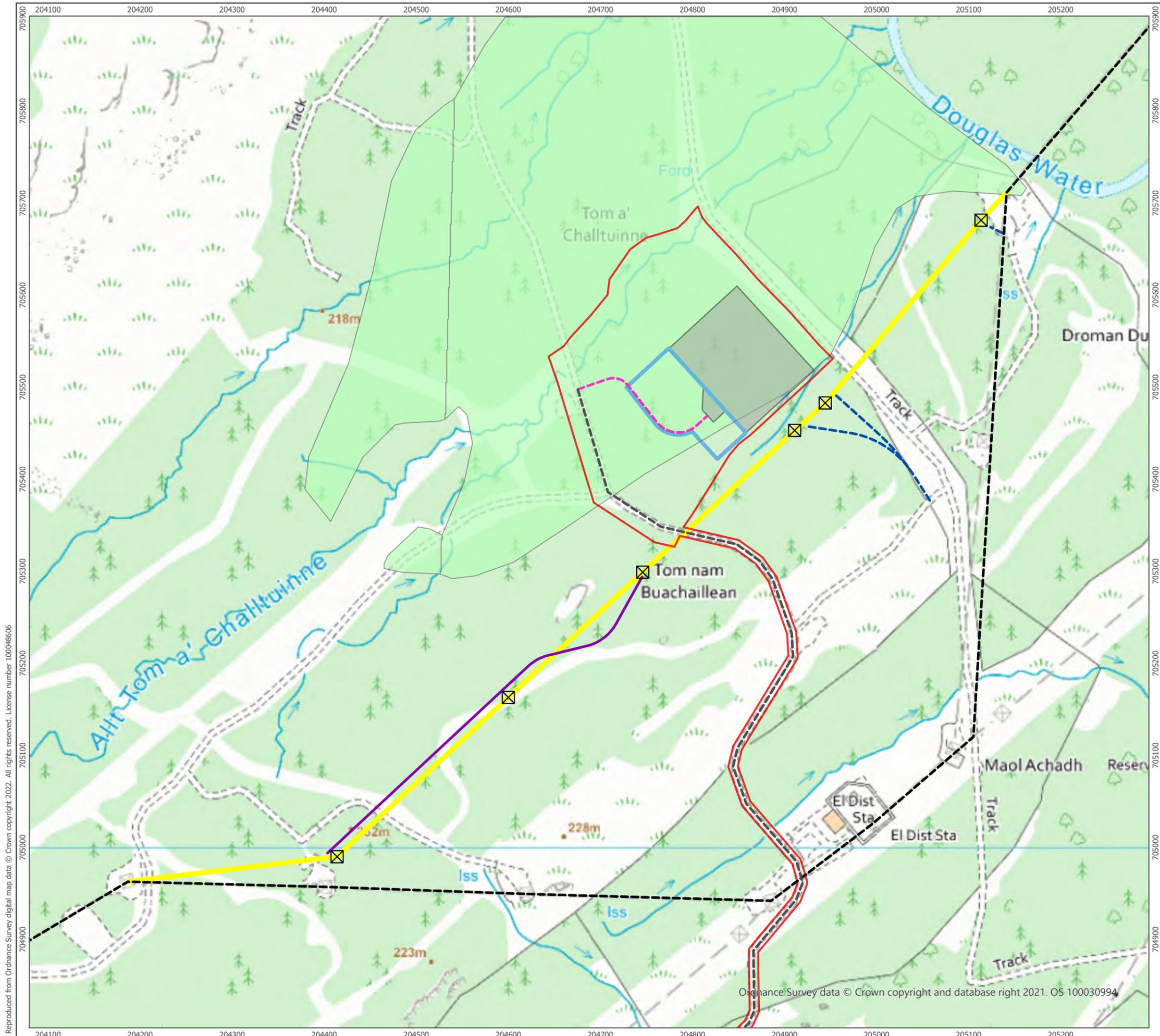
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Checked By: SC	Date: 10/05/2022

Site Layout Plan
Figure 1

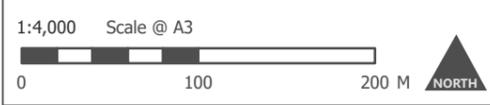
An Suidhe
Annex O: Peat Slide
Risk Assessment

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- Existing Inveraray to Crossaig Overhead Line
- Existing Access Track
- Proposed Development**
- Indicative Town and Country Planning Boundary
- Proposed Substation Temporary Works Area
- Proposed Substation Layout
- Proposed Permanent Access Track
- Associated Development**
- Proposed Permanent Access Track
- Proposed Temporary Tracks
- Proposed OHL Alignment
- X Tower Location
- Superficial Soils**
- Till, Devensian



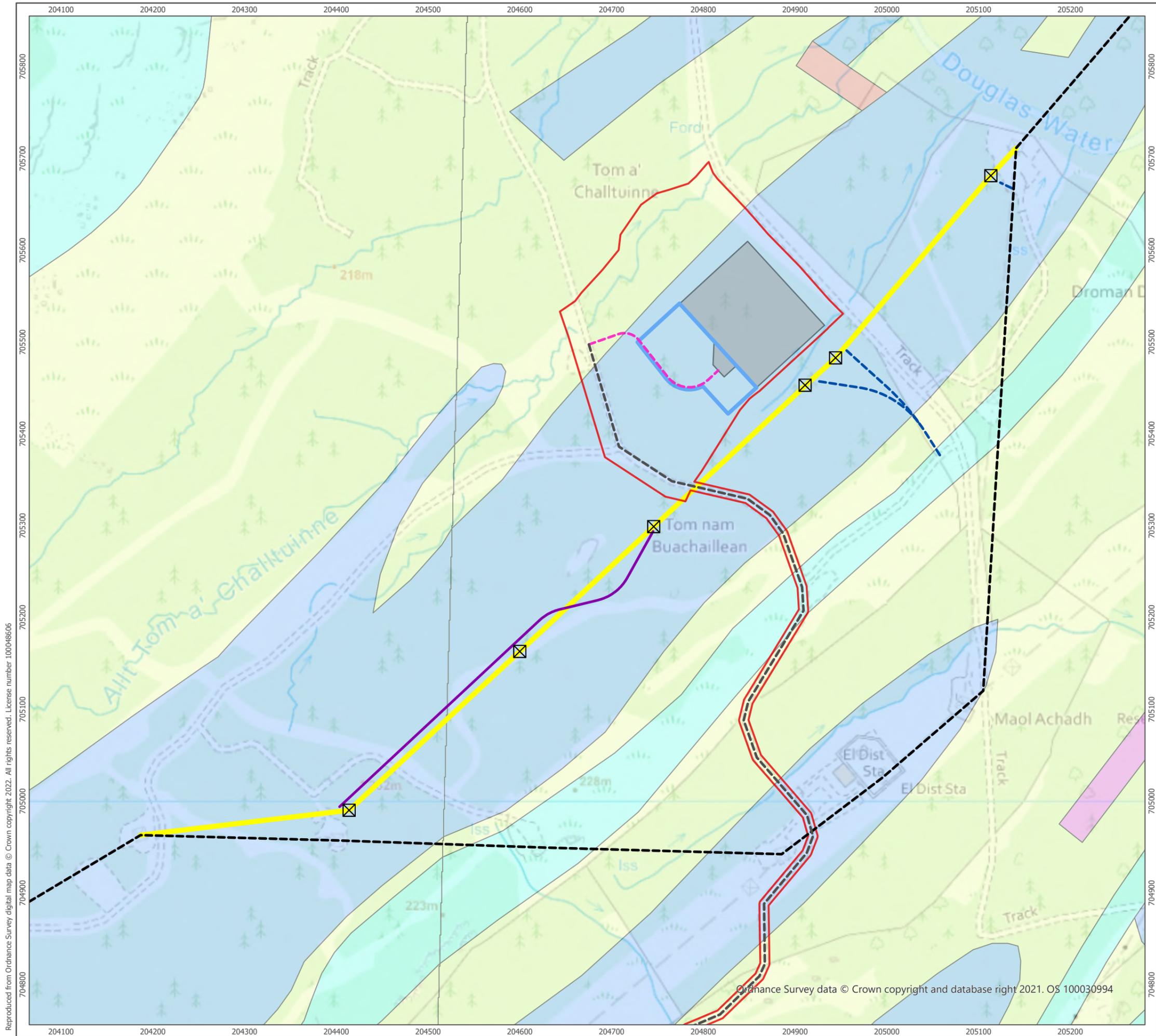
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Superficial Soils
Figure 2

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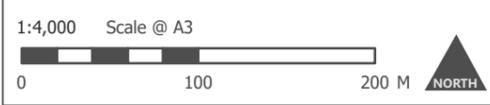
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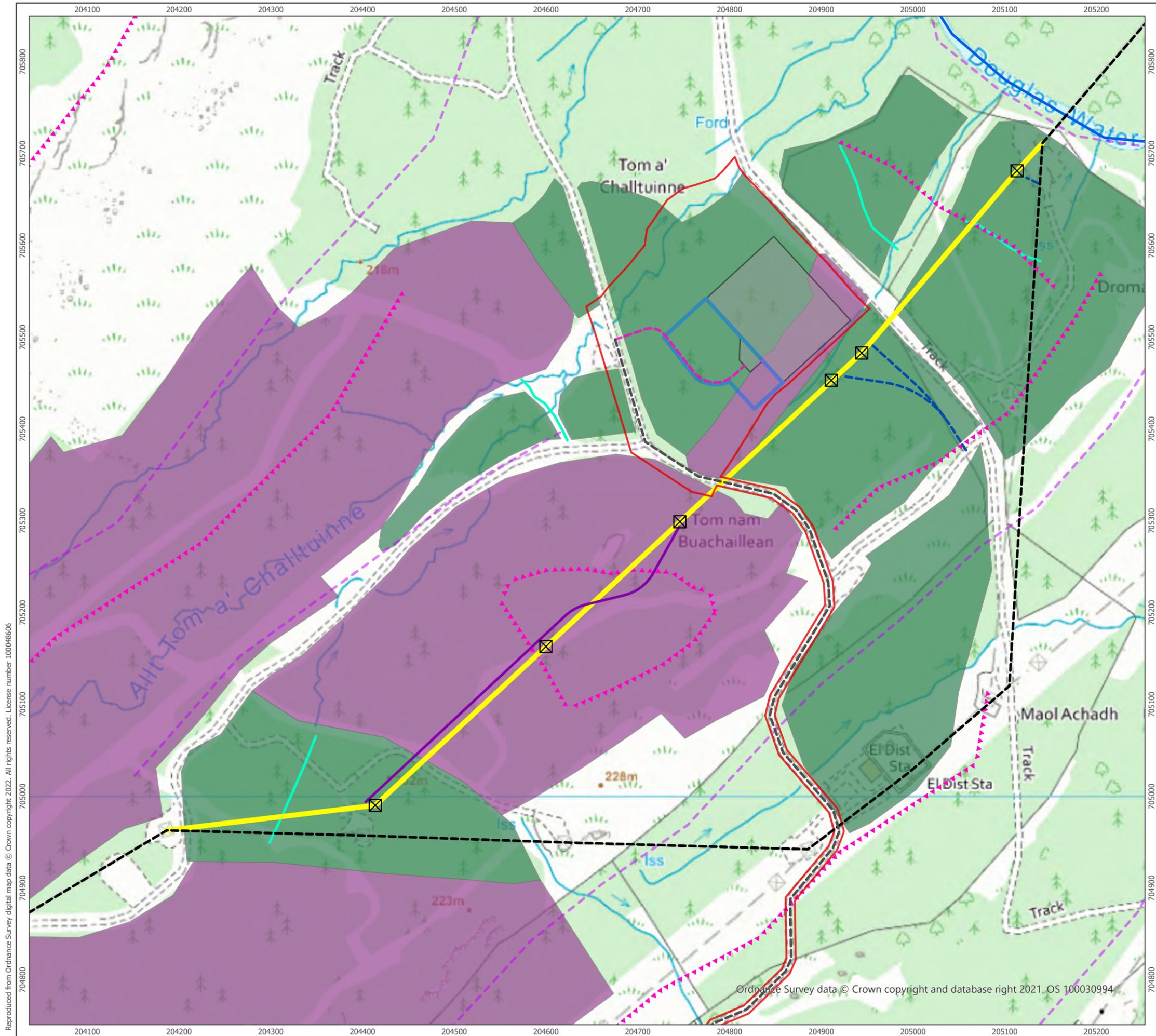
- Existing Access Track
- Existing Inveraray to Crossaig Overhead Line
- Proposed Development**
- ▭ Indicative Town and Country Planning Boundary
- ▭ Proposed Substation Temporary Works Area
- ▭ Proposed Substation Layout
- Proposed Permanent Access Track
- Associated Development**
- Proposed Permanent Access Track
- Proposed Temporary Tracks
- Proposed OHL Alignment
- ⊠ Tower Location
- Solid Geology**
- ▭ Ardrishaig Phyllite Formation
- ▭ Argyll Group
- ▭ Dalradian Supergroup
- ▭ Mull Dyke-Swarm
- ▭ Scottish Highland Siluro-Devonian Calc-Alkaline Minor Intrusion Suite (Other Than Dykes)



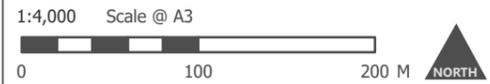
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Solid Geology
Figure 3

An Suidhe
Annex O: Peat Slide
Risk Assessment



- Existing Access Track
- Existing Inveraray to Crossaig Overhead Line
- Proposed Development**
- ▭ Indicative Town and Country Planning Boundary
- ▭ Proposed Substation Temporary Works Area
- ▭ Proposed Substation Layout
- Proposed Permanent Access Track
- Associated Development**
- Proposed Permanent Access Track
- Proposed Temporary Tracks
- Proposed OHL Alignment
- ⊠ Tower Location
- Geomorphology**
- ▽ Top of Slope
- Bottom of Slope
- Artificial Drainage
- Major Watercourse
- Deforested Area
- Mature Forestry



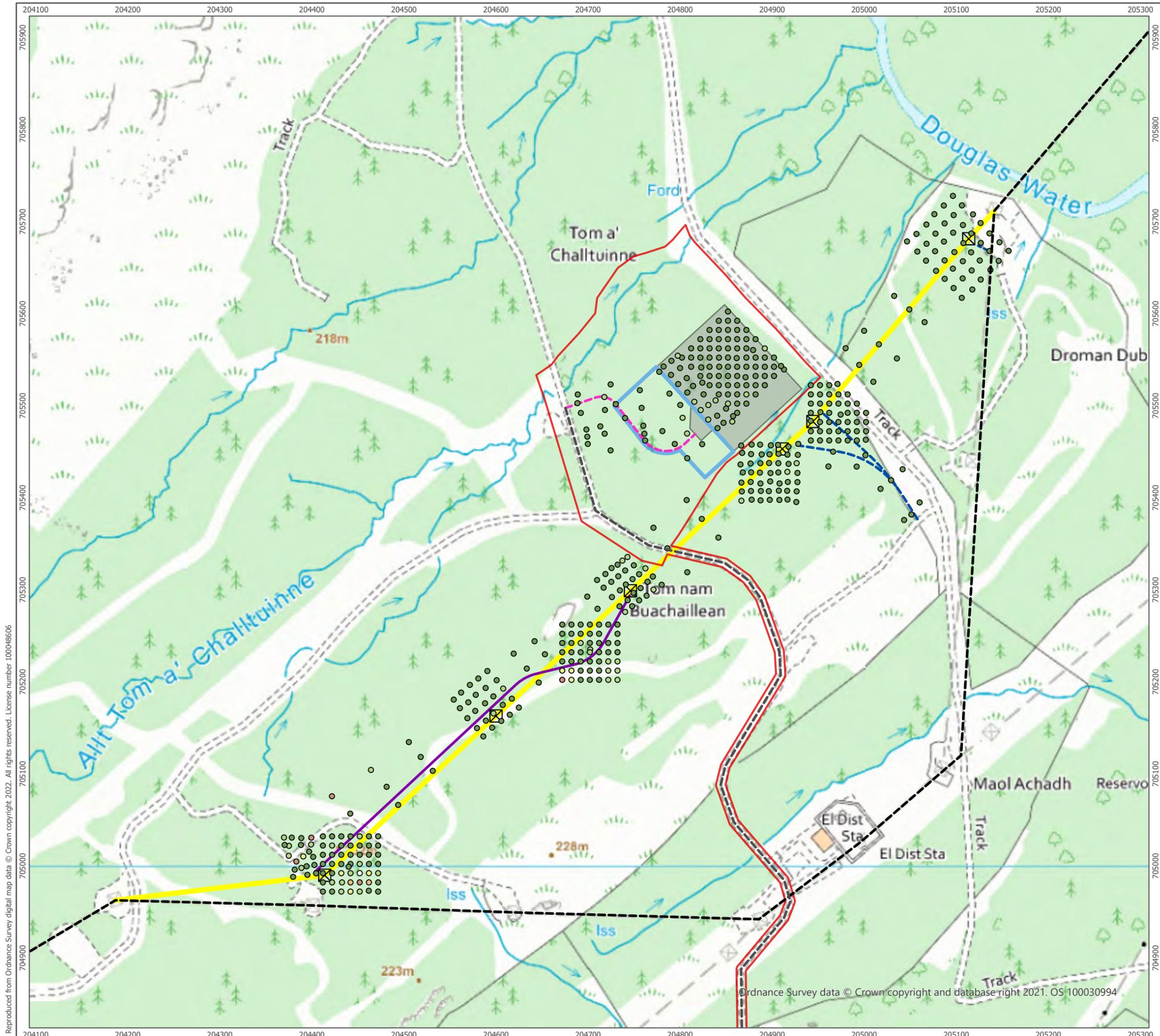
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Geomorphology Map
Figure 4

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- Existing Access Track
- Existing Inveraray to Crossaig Overhead Line
- Proposed Development**
- Indicative Town and Country Planning Boundary
- Proposed Permanent Access Track
- Proposed Substation Temporary Works Area
- Proposed Substation Layout
- Associated Development**
- Proposed Permanent Access Track
- Proposed Temporary Tracks
- Proposed OHL Alignment
- Tower Location
- Recorded Peat Depths (m)**
- 0.01 - 0.50
- 0.51 - 1.50
- 1.51 - 2.00
- 2.01 - 2.50
- 2.51 - 3.00
- 3.01 - 3.50
- 3.51 - 4.00

1:4,000 Scale @ A3

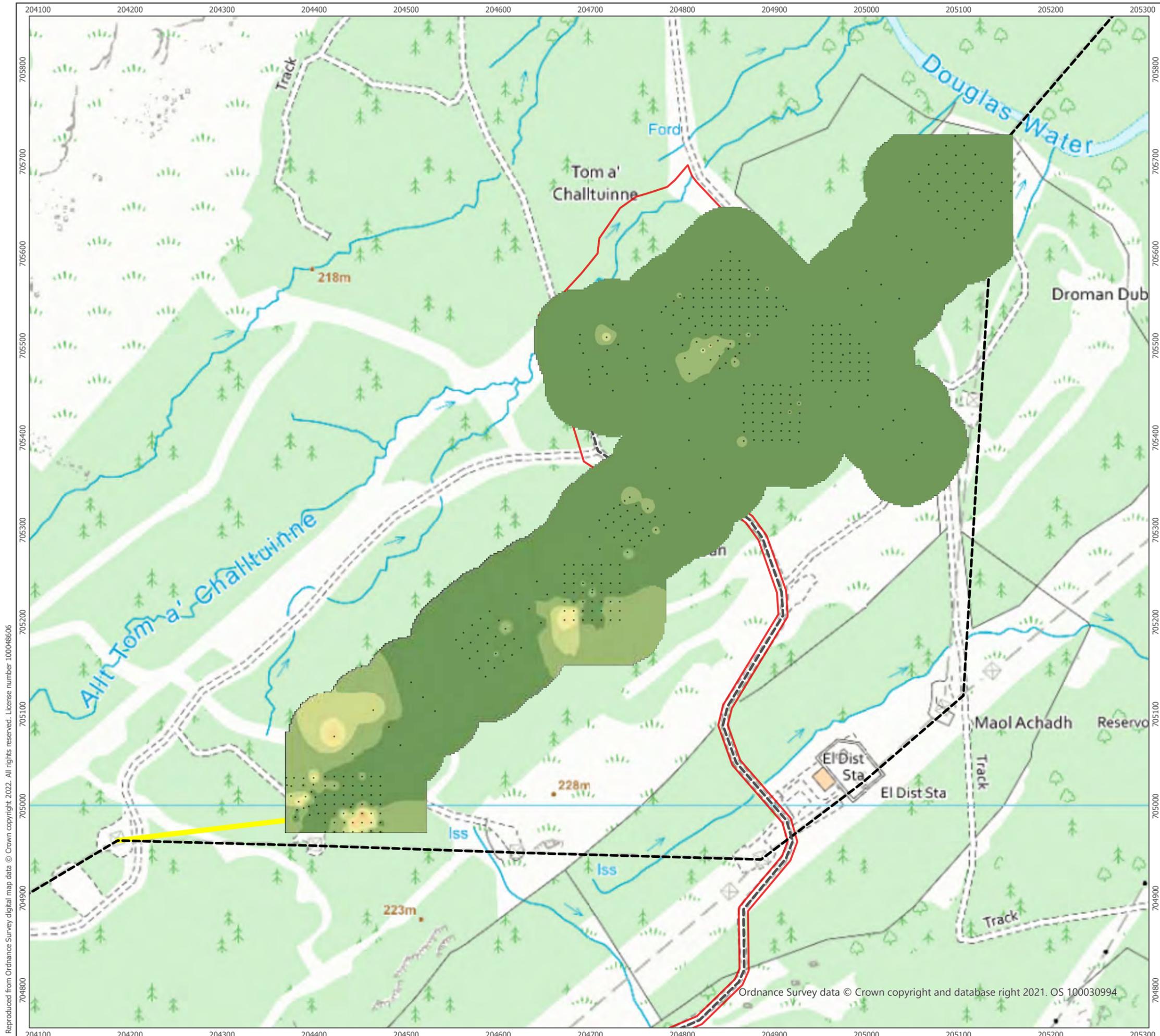


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Recorded Peat Depths
Figure 5

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Annex O: Peat Slide
Risk Assessment

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- Existing Access Track
- Existing Inveraray to Crossaig Overhead Line
- Peat Probe Location
- Proposed Development**
- ▭ Indicative Town and Country Planning Boundary
- ▭ Proposed Substation Temporary Works Area
- ▭ Proposed Substation Layout
- Proposed Permanent Access Track
- Associated Development**
- Proposed Permanent Access Track
- Proposed Temporary Tracks
- Proposed OHL Alignment
- ⊠ Tower Location
- Interpolated Peat Depths (m)**
- 0.00 - 0.50
- 0.51 - 1.00
- 1.01 - 1.50
- 1.51 - 2.00
- 2.01 - 2.50
- 2.51 - 3.00
- 3.01 - 3.50
- 3.51 - 4.00

1:4,000 Scale @ A3

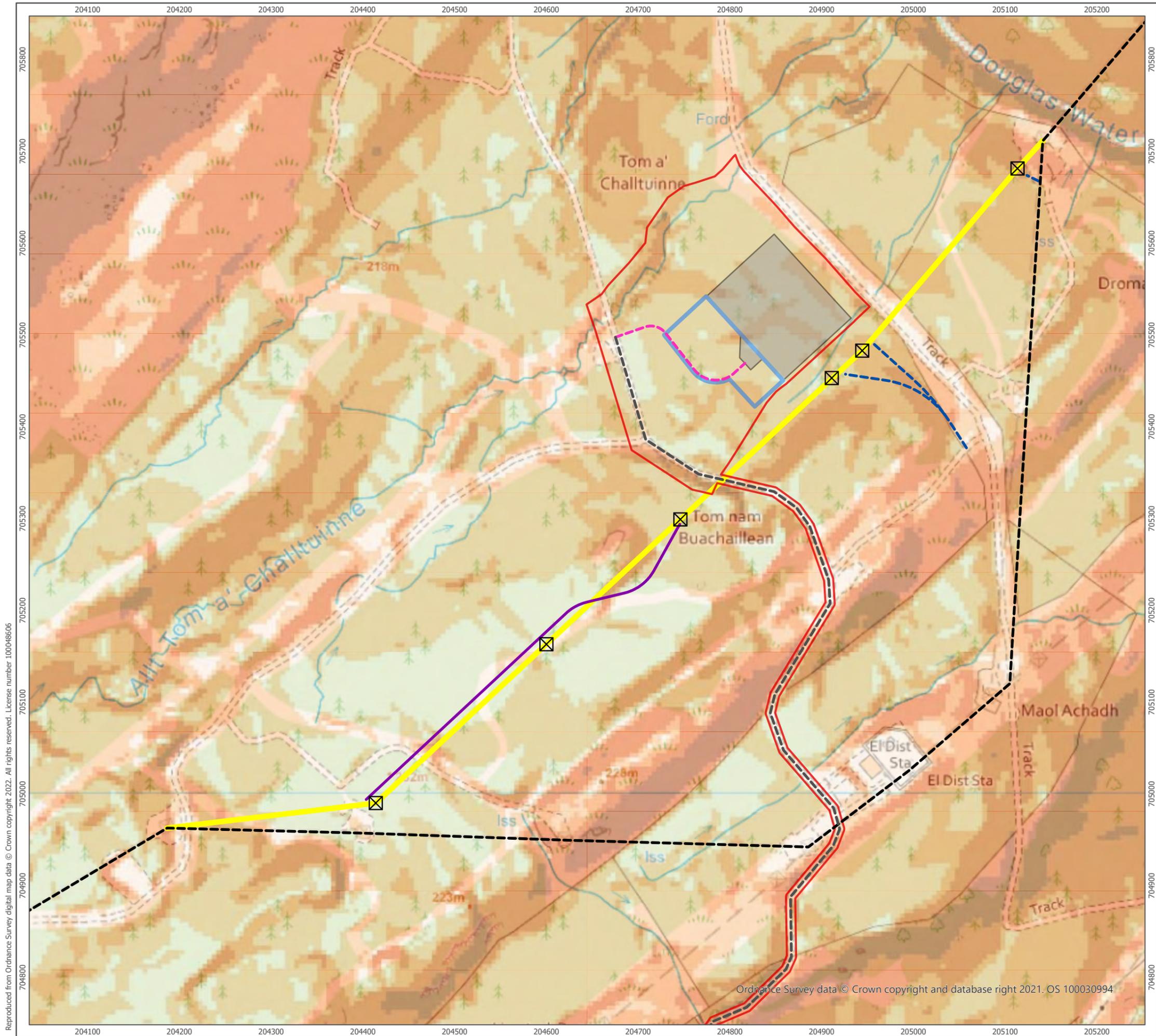
0 100 200 M NORTH

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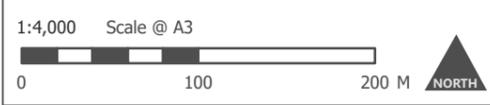
Interpolated Peat Depths
Figure 6

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- Existing Access Track
- Existing Inveraray to Crossaig Overhead Line
- Proposed Development**
- Indicative Town and Country Planning Boundary
- Proposed Substation Temporary Works Area
- Proposed Substation Layout
- Proposed Permanent Access Track
- Associated Development**
- Proposed Permanent Access Track
- Proposed Temporary Tracks
- Proposed OHL Alignment
- X Tower Location
- Slope Gradient (degrees)**
- 0 - 5
- 5 - 10
- 10 - 15
- 15 - 30
- 30 +



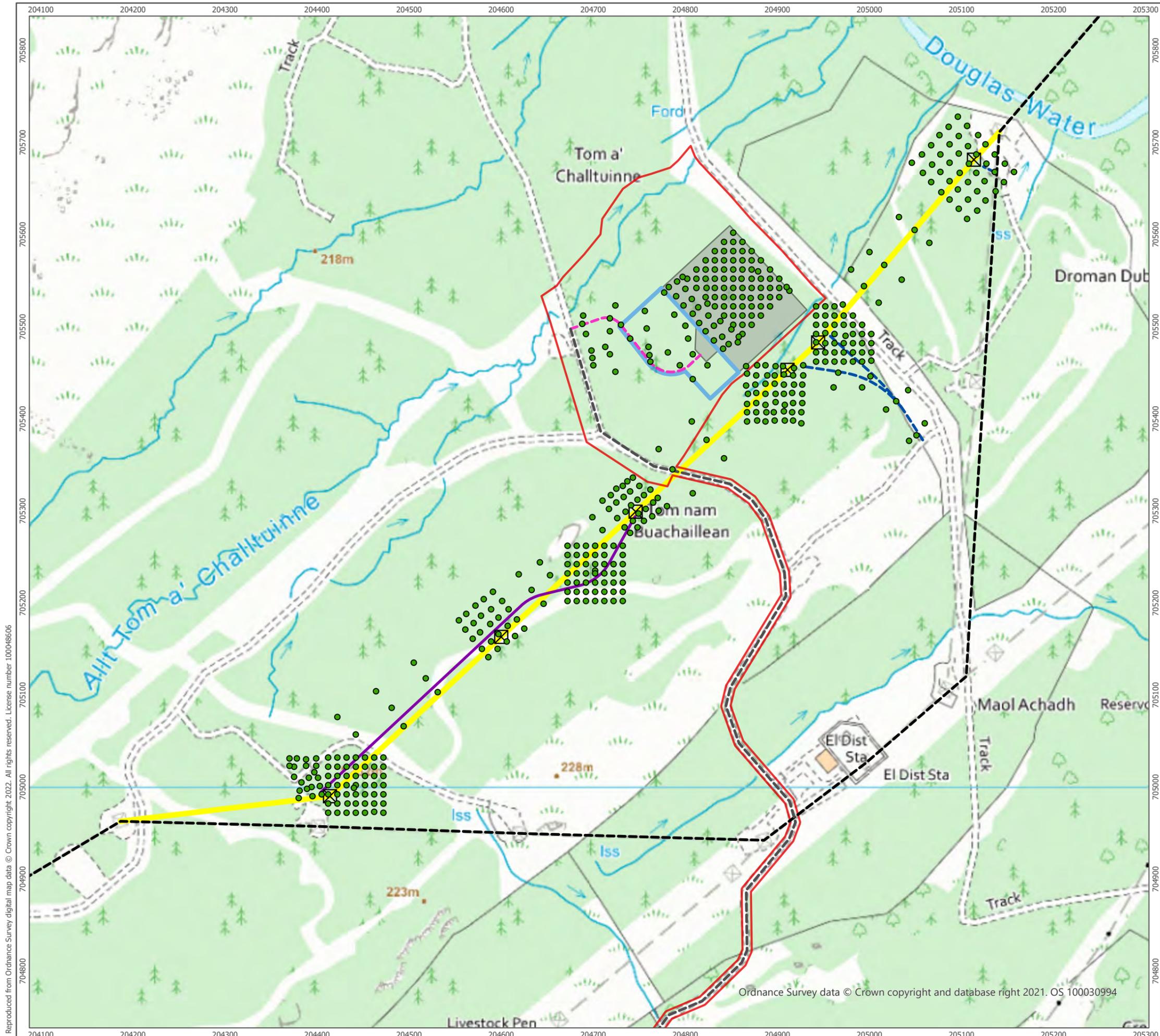
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Slope Gradient
Figure 7

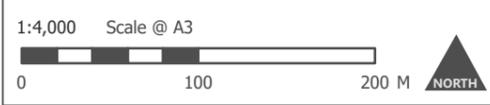
An Suidhe
Annex O: Peat Slide
Risk Assessment

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- Existing Access Track
- Existing Inveraray to Crossaig Overhead Line
- Proposed Development**
- Indicative Town and Country Planning Boundary
- Proposed Permanent Access Track
- Proposed Substation Temporary Works Area
- Proposed Substation Layout
- Associated Development**
- Proposed Permanent Access Track
- Proposed Temporary Tracks
- Proposed OHL Alignment
- Tower Location
- Factor of Safety**
- Low Risk



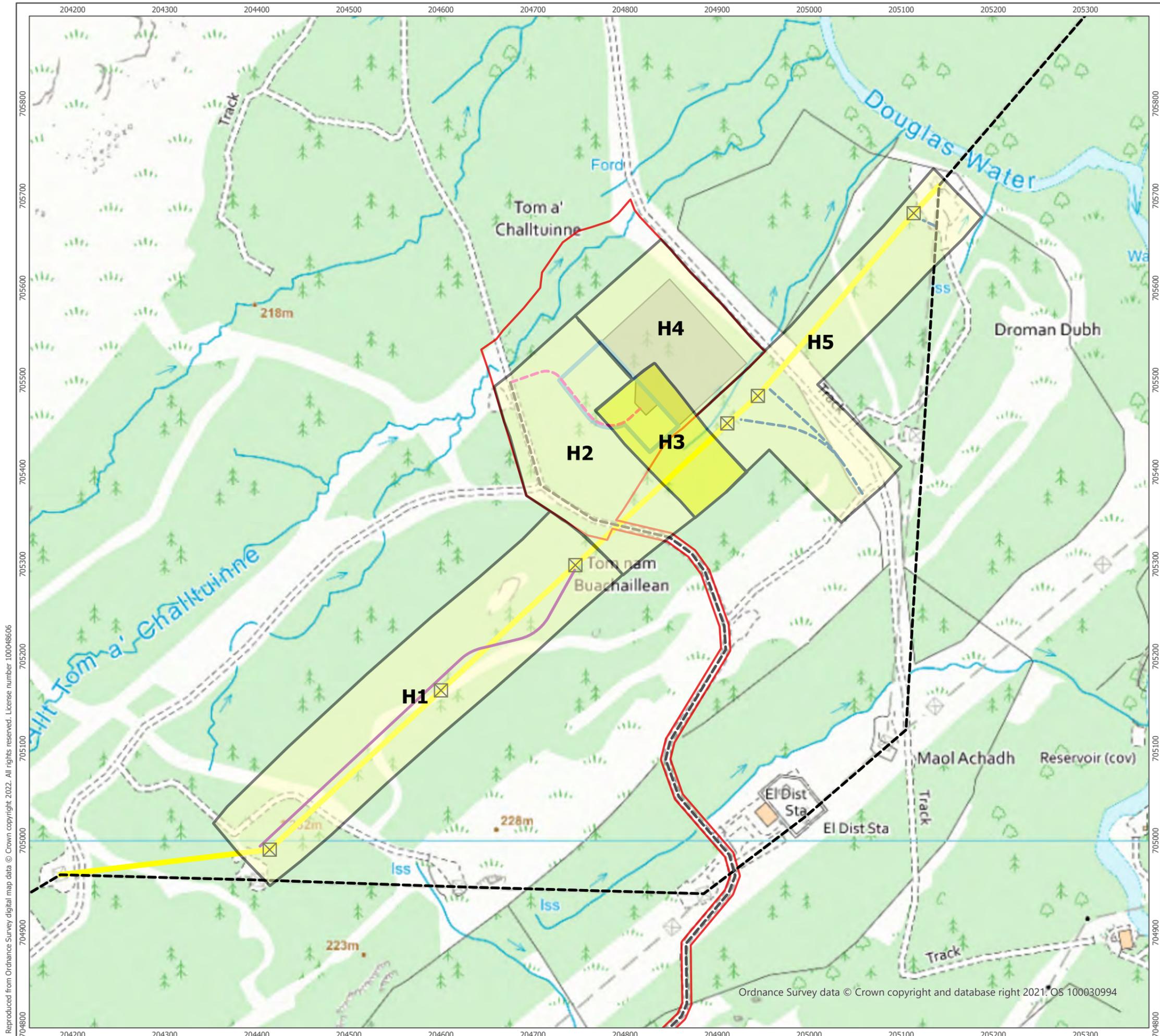
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Factor of Safety Plan
Figure 8

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Risk Assessment

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- Existing Access Track
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- Proposed Permanent Access Track
- Proposed Substation Temporary Works Area
- Proposed Substation Layout
- Associated Development**
- Proposed Permanent Access Track
- Proposed Temporary Tracks
- Proposed OHL Alignment
- Tower Location
- Hazard Rank Zonation**
- Negligible
- Low

1:4,000 Scale @ A3

0 100 200 M NORTH

Produced By: CR	Ref: 4534-REP-014
Checked By: DB	Date: 16/05/2022

Hazard Rank Zonation Plan
Figure 9

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Annex O: Peat Slide
Risk Assessment

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APPENDIX B - SITE PHOTOGRAPHS

Photograph 1 – View east in area of proposed substation, TWA and track



Photograph 2 – View north east from central Site area



Photograph 3 – View north west from central Site area



Photograph 4 – View west from proposed tower location within area of forestry



Photograph 5 – View north west from the southern area of the Site



Photograph 6 – View north west of existing track network in southern Site area



APPENDIX C – HAZARD RANK ASSESSMENT RECORDS



ID	X	Y	Z	SLOPE	Slope Co-efficient	PEAT DEPTH	Peat Level	Peat Co-efficient	Gen Substrate	Substrate Co-eff.	Risk Rating Coefficient	Risk Rating Normalisation	Receptor	Receptor Co-eff.	Z Receptor	Distance	Receptor Dist Co-eff.	Z Difference (mmow-/-)	Receptor elevation Co-eff	Impact Rating	Impact Rating Normalisation	Hazard Ranking
1	204812	705542	172.378996	6.66036	0.1	172.278996	G	0.1	172.278996	1	4	2	Site Infrastructure	0.941664	0	0.028245	0.028245	1	12	2	4	
2	204812	705552	171.338244	6.52077	0.1	171.238244	G	0.1	171.238244	1	4	2	Site Infrastructure	0.941664	0	0.065505	0.065505	1	12	2	4	
3	204802	705512	171.496867	6.90456	0.1	171.466867	G	0.1	171.466867	1	1,5	2	Site Infrastructure	0.941664	0	0.064149	0.064149	1	12	2	4	
4	204812	705552	170.140631	8.083706	0.01	170.130631	G	0.01	170.130631	1	6	2	Site Infrastructure	0.941664	0	0.070969	0.070969	1	12	2	4	
5	204822	705562	168.958933	14.329200	0.01	168.948933	G	0.01	168.948933	1	6	2	Site Infrastructure	0.941664	0	-0.01931	-0.01931	1	12	2	4	
6	204822	705572	167.040307	16.171000	0.4	167.040307	G	0.4	167.040307	1	6	2	Site Infrastructure	0.941664	0	0.03594	0.03594	1	12	2	4	
7	204832	705572	166.873458	6.98650	0.3	166.573458	G	0.3	166.573458	1	4	1	Site Infrastructure	0.941664	0	0.03269	0.03269	1	12	2	4	
8	204832	705582	165.792897	6.936371	0.4	165.392897	G	0.4	165.392897	1	4	1	Site Infrastructure	0.941664	0	0.032709	0.032709	1	12	2	4	
9	204842	705582	165.214737	7.58781	0.1	165.114737	G	0.1	165.114737	1	4	1	Site Infrastructure	0.941664	0	0.029296	0.029296	1	12	2	4	
10	204842	705592	164.183484	7.293161	0.01	164.129316	G	0.01	164.129316	1	6	2	Site Infrastructure	0.941664	0	0.028242	0.028242	1	12	2	4	
11	204852	705592	163.129866	8.840747	0.01	163.119866	G	0.01	163.119866	1	6	2	Site Infrastructure	0.941664	0	-0.022703	-0.022703	1	12	2	4	
12	204852	705602	162.175136	8.415159	0.01	162.165136	G	0.01	162.165136	1	6	2	Site Infrastructure	0.941664	0	-0.004455	-0.004455	1	12	2	4	
13	204862	705562	159.67663	8.862926	0.4	161.47663	G	0.4	161.47663	1	6	2	Site Infrastructure	0.941664	0	-0.024095	-0.024095	1	12	2	4	
14	204872	705582	162.422889	10.674632	0.1	162.322889	G	0.1	162.322889	1	6	2	Site Infrastructure	0.941664	0	0.060606	0.060606	1	12	2	4	
15	204882	705572	163.33851	10.25821	0.01	163.32851	G	0.01	163.32851	1	6	2	Site Infrastructure	0.941664	0	0.066953	0.066953	1	12	2	4	
16	204892	705562	164.280059	12.100916	0.6	163.680059	G	0.6	163.680059	1	12	2	Site Infrastructure	0.941664	0	-0.207176	-0.207176	1	12	2	4	
17	204902	705552	164.442695	13.912623	0.01	164.432695	G	0.01	164.432695	1	6	2	Site Infrastructure	0.941664	0	-0.330302	-0.330302	1	12	2	4	
18	204913	705539	164.043422	10.509993	0.01	164.033422	G	0.01	164.033422	1	6	2	Site Infrastructure	0.941664	0	-0.354263	-0.354263	1	12	2	4	
19	204920	705542	164.184742	11.719155	0.01	164.174742	G	0.01	164.174742	1	6	2	Site Infrastructure	0.941664	0	-0.092751	-0.092751	1	12	2	4	
20	204902	705512	167.195359	10.465200	0.01	167.185359	G	0.01	167.185359	1	6	2	Site Infrastructure	0.941664	0	-0.052138	-0.052138	1	12	2	4	
21	204902	705542	165.912393	14.081486	0.2	165.712393	G	0.2	165.712393	1	6	2	Site Infrastructure	0.941664	0	-0.051963	-0.051963	1	12	2	4	
22	204892	705542	167.880501	11.34047	0.01	167.870501	G	0.01	167.870501	1	6	2	Site Infrastructure	0.941664	0	0.046394	0.046394	1	12	2	4	
23	204892	705542	166.944619	12.798213	0.2	166.844619	G	0.2	166.844619	1	6	2	Site Infrastructure	0.941664	0	0.059578	0.059578	1	12	2	4	
24	204882	705552	166.816617	9.948948	0.4	166.416617	R	0.4	166.416617	1,5	6	2	Site Infrastructure	0.941664	0	0.08708	0.08708	1	12	2	4	
25	204872	705552	167.182296	8.93384	0.2	166.982296	G	0.2	166.982296	1	6	2	Site Infrastructure	0.941664	0	0.063377	0.063377	1	12	2	4	
26	204879	705560	165.165455	7.95056	0.01	165.155455	G	0.01	165.155455	1	6	2	Site Infrastructure	0.941664	0	0.065352	0.065352	1	12	2	4	
27	204872	705562	165.685443	9.688876	0.01	165.675443	G	0.01	165.675443	1	6	2	Site Infrastructure	0.941664	0	0.050429	0.050429	1	12	2	4	
28	204872	705572	164.088508	10.091010	0.01	164.085008	G	0.01	164.085008	1	6	2	Site Infrastructure	0.941664	0	0.055273	0.055273	1	12	2	4	
29	204852	705572	164.848508	10.225210	0.01	164.808508	G	0.01	164.808508	1	6	2	Site Infrastructure	0.941664	0	0.056392	0.056392	1	12	2	4	
30	204862	705582	163.188582	10.222400	0.01	163.178582	G	0.01	163.178582	1	6	2	Site Infrastructure	0.941664	0	0.055483	0.055483	1	12	2	4	
31	204852	705582	164.080734	9.035432	0.01	164.070734	G	0.01	164.070734	1	6	2	Site Infrastructure	0.941664	0	-0.01297	-0.01297	1	12	2	4	
32	204842	705572	166.201345	7.945315	0.01	166.201345	G	0.01	166.201345	1	6	2	Site Infrastructure	0.941664	0	0.033387	0.033387	1	12	2	4	
33	204852	705572	165.548798	8.463716	0.01	165.548798	G	0.01	165.548798	1	6	2	Site Infrastructure	0.941664	0	0.030207	0.030207	1	12	2	4	
34	204852	705562	167.035313	8.422224	0.01	167.025313	G	0.01	167.025313	1	6	2	Site Infrastructure	0.941664	0	0.046069	0.046069	1	12	2	4	
35	204862	705562	168.373132	9.064446	0.2	168.173132	G	0.2	168.173132	1	6	2	Site Infrastructure	0.941664	0	0.050041	0.050041	1	12	2	4	
36	204872	705542	168.794217	9.254146	0.5	168.344217	G	0.5	168.344217	1	6	2	Site Infrastructure	0.941664	0	0.079346	0.079346	1	12	2	4	
37	204882	705542	168.383546	9.013339	0.2	168.183546	G	0.2	168.183546	1	6	2	Site Infrastructure	0.941664	0	0.077377	0.077377	1	12	2	4	
38	204892	705532	168.615658	8.104898	0.01	168.605658	G	0.01	168.605658	1	6	2	Site Infrastructure	0.941664	0	-0.08308	-0.08308	1	12	2	4	
39	204892	705542	168.503964	7.820129	0.2	168.503964	G	0.2	168.503964	1	6	2	Site Infrastructure	0.941664	0	-0.08955	-0.08955	1	12	2	4	
40	204882	705522	170.078042	7.581199	0.1	170.068042	G	0.1	170.068042	1	4	1	Site Infrastructure	0.941664	0	-0.078874	-0.078874	1	12	2	4	
41	204882	705512	170.511465	10.72491	0.2	170.311465	G	0.2	170.311465	1	6	2	Site Infrastructure	0.941664	0	-0.057208	-0.057208	1	12	2	4	
42	204872	705522	173.387587	7.940791	0.2	173.187587	G	0.2	173.187587	1	6	2	Site Infrastructure	0.941664	0	-0.062929	-0.062929	1	12	2	4	
43	204882	705512	169.709507	7.040591	0.01	169.709507	G	0.01	169.709507	1	6	2	Site Infrastructure	0.941664	0	0.028001	0.028001	1	12	2	4	
44	204871	705531	170.288897	9.325453	0.01	170.288897	R	0.01	170.288897	1,5	6	2	Site Infrastructure	0.941664	0	0.010391	0.010391	1	12	2	4	
45	204862	705532	170.815738	10.504446	0.01	170.805738	G	0.01	170.805738	1	6	2	Site Infrastructure	0.941664	0	0.150124	0.150124	1	12	2	4	
46	204862	705542	169.110929	7.807209	0.01	169.110929	G	0.01	169.110929	1	6	2	Site Infrastructure	0.941664	0	0.069025	0.069025	1	12	2	4	
47	204861	705522	167.866959	8.578797	0.2	167.666959	R	0.2	167.666959	1,5	6	2	Site Infrastructure	0.941664	0	-0.120608	-0.120608	1	12	2	4	
48	204852	705552	168.351684	7.409311	0.1	168.251684	R	0.1	168.251684	1,5	6	2	Site Infrastructure	0.941664	0	0.088855	0.088855	1	12	2	4	
49	204842	705542	167.503845	7.090904	0.1	167.493845	R	0.1	167.493845	1,5	6	2	Site Infrastructure	0.941664	0	0.053186	0.053186	1	12	2	4	
50	204832	705562	167.964303	7.774923	0.2	167.764303	G	0.2	167.764303	1,5	6	2	Site Infrastructure	0.941664	0	0.094117	0.094117	1	12	2	4	
51	204822	705552	171.208815	9.943203	0.4	170.808815	G	0.4	170.808815	1	6	2	Site Infrastructure	0.941664	0	0.079237	0.079237	1	12	2	4	
52	204831	705512	165.532155	11.294179	0.5	165.132155	G	0.5	165.132155	1	6											

160	204982	705002	160.65298	12.901290	0.1	160.552981	R	1,5	9	2	Roads and Tracks	3	159.975203	2.96185	4	0.800095	1	12	4
161	204982	705492	161.773646	12.294113	0.2	161.573646	G	1	1	1	Roads and Tracks	3	160.033666	6.992717	4	1.73998	1	12	4
162	204992	705492	159.984238	5.09944	0.3	159.884238	G	1	1	1	Roads and Tracks	3	159.879007	14.75765	4	0.110311	1	12	2
163	204992	705482	161.155033	12.105033	0.1	161.055033	G	1	1	1	Roads and Tracks	3	160.979526	8.520497	4	1.475504	1	12	12
164	205002	705482	159.53132	5.452921	0.1	159.43132	G	1	1	1	Roads and Tracks	3	159.459007	14.75765	4	0.074125	1	12	2
165	205002	705472	161.189761	13.519779	0.2	160.999761	G	1	1	1	Roads and Tracks	3	159.477726	8.520496	4	1.662035	1	12	2
166	205002	705463	162.186646	13.683646	0.1	162.086646	G	1	1	1	Site Infrastructure	6	165.003785	8.807497	4	-1.271385	1	12	12
167	204992	705462	164.585245	14.858995	0.4	164.185245	G	1	1	1	Site Infrastructure	6	164.990674	1.506654	4	-0.405429	1	12	4
168	204992	705472	162.875031	13.518006	0.1	162.775031	G	1	1	1	Site Infrastructure	6	164.886311	8.520496	4	-2.01128	1	12	4
169	204982	705462	166.223272	15.580246	0.3	166.023272	G	1	1	1	Site Infrastructure	6	166.538404	2.96185	4	0.883168	1	12	2
170	204982	705472	164.572982	13.139796	0.4	164.172982	G	1	1	1	Site Infrastructure	6	165.127071	2.99618	4	-0.144119	1	12	12
171	204972	705472	166.094885	12.953064	0.01	166.084885	G	1	1	1	Site Infrastructure	6	165.779833	14.75765	4	0.316652	1	12	2
172	204972	705462	167.912391	15.981118	0.01	167.902391	G	1	1	1	Site Infrastructure	6	165.505309	9.893888	4	2.407082	1	12	4
173	204972	705482	162.873225	12.520321	0.3	162.773225	G	1	1	1	Site Infrastructure	6	165.12881	9.506417	4	-1.305985	1	12	12
174	204974	705480	163.165016	8.531952	0.3	162.865016	R	1,5	9	2	Site Infrastructure	6	164.900203	10.58587	3	-1.735187	1	9	1
175	204962	705482	163.983261	9.852599	0.2	163.783261	R	1,5	9	2	Site Infrastructure	6	164.016169	34.13648	4	-0.698429	1	12	2
176	204962	705482	165.933366	12.914796	0.2	165.833366	R	1,5	9	2	Site Infrastructure	6	165.493204	14.76976	4	0.307112	1	12	2
177	204972	705482	164.344429	11.541451	0.5	163.844429	G	1	1	1	Site Infrastructure	6	164.972209	2.99618	4	-0.62778	1	12	4
178	204962	705472	167.580395	12.526789	0.4	167.180395	G	1	1	1	Site Infrastructure	6	165.620209	8.520496	4	1.960186	1	12	2
179	204962	705462	169.484869	12.462789	0.2	169.284869	G	1	1	1	Site Infrastructure	6	172.221916	9.389914	4	-1.773449	1	12	4
180	204867	705397	184.741946	16.229155	0.7	184.041946	R	1,5	24	3	Minor Water Feature	6	180.158983	28.315769	3	4.582963	1	18	2
181	204867	705407	182.478992	10.828977	0.5	181.978992	R	1,5	9	2	Minor Water Feature	6	180.158983	18.40775	3	2.120009	1	18	2
182	204867	705416	180.943334	9.514466	0.5	180.413334	G	1,5	9	2	Minor Water Feature	6	180.158983	9.039388	4	0.757331	1	24	9
183	204867	705427	179.3929	7.981961	0.4	178.8929	G	1,5	9	2	Minor Water Feature	6	178.97317	1.608212	4	0.016169	1	24	9
184	204867	705449	178.210118	5.344295	0.4	177.910118	G	1,5	9	2	Site Infrastructure	6	178.538692	6.699225	4	-0.329574	1	12	2
185	204866	705436	178.827781	6.966574	0.4	178.427781	G	1,5	9	2	Minor Water Feature	6	178.942864	6.453462	4	-0.115083	1	24	9
186	204866	705436	178.827781	6.137394	0.01	178.827781	G	1,5	9	2	Site Infrastructure	6	175.952536	8.120915	4	-0.416568	1	12	2
187	204866	705457	178.000491	5.90314	0.4	177.600491	G	1	1	1	Minor Water Feature	6	177.818384	2.401303	4	0.182107	1	24	9
188	204877	705447	177.313799	6.008486	0.01	177.213799	G	1	1	1	Minor Water Feature	6	176.911746	7.601484	4	0.420233	1	24	3
189	204876	705437	177.204228	5.860771	0.3	177.004228	G	1	1	1	Minor Water Feature	6	177.773028	5.860771	4	0.053166	1	24	4
190	204877	705428	178.480533	8.917007	0.1	178.180533	G	1	1	1	Minor Water Feature	6	178.336906	6.537714	4	0.143627	1	24	3
191	204877	705417	180.417893	11.188427	0.1	180.317893	G	1,5	9	2	Minor Water Feature	6	178.732164	14.76663	3	1.685729	1	18	2
192	204887	705415	181.084763	16.041218	0.01	181.084763	G	1,5	9	2	Minor Water Feature	6	178.732164	22.207994	3	2.362599	1	18	2
193	204877	705407	182.505466	13.833746	0.4	182.105466	G	1,5	9	2	Minor Water Feature	6	182.505466	2.364685	4	2.364685	1	18	2
194	204878	705398	185.793552	19.903426	0.1	185.693552	G	1,5	9	2	Minor Water Feature	6	180.158983	30.59305	3	5.580369	1	18	2
195	204887	705397	187.261563	19.210808	0.1	187.141563	G	1,5	9	2	Minor Water Feature	6	180.158983	36.70026	3	7.08258	1	18	2
196	204886	705403	183.819466	13.810939	0.1	183.719466	G	1,5	9	2	Minor Water Feature	6	183.819466	5.587102	4	0.016169	1	18	2
197	204897	705398	187.691353	18.027488	0.3	187.391353	G	1,5	9	2	Minor Water Feature	6	178.732164	42.38206	3	8.96089	1	18	2
198	204896	705407	184.613764	17.995113	0.3	184.313764	G	1,5	9	2	Minor Water Feature	6	178.732164	34.520613	3	5.8816	1	18	2
199	204908	705406	188.238924	17.099718	0.2	188.138924	G	1,5	9	2	Minor Water Feature	6	178.732164	49.042613	3	11.058249	1	18	2
200	204917	705398	189.011948	12.694446	0.4	188.611948	G	1,5	9	2	Site Infrastructure	6	174.943367	50.971602	3	14.06581	1	18	2
201	204926	705398	189.240746	11.152931	0.3	188.940746	G	1,5	9	2	Site Infrastructure	6	174.943367	55.09888	3	14.297379	1	18	2
202	204926	705407	186.202084	18.480584	0.1	186.102084	G	1,5	9	2	Site Infrastructure	6	174.943367	44.00882	3	11.348717	1	18	2
203	204916	705407	186.894302	16.472288	0.1	186.794302	G	1,5	9	2	Site Infrastructure	6	174.943367	41.00882	3	11.950935	1	18	2
204	204907	705408	185.534379	17.636453	0.1	185.434379	G	1,5	12	2	Minor Water Feature	6	177.286805	40.542726	3	8.265774	1	18	2
205	204908	705415	183.335107	19.908988	0.4	183.035107	G	1,5	12	2	Site Infrastructure	6	175.400437	33.62657	3	7.93267	1	9	1
206	204898	705418	183.384878	18.204481	0.1	183.284878	G	1,5	12	2	Minor Water Feature	6	174.943367	34.664043	3	4.026673	1	9	1
207	204917	705417	183.366888	20.888872	0.1	183.266888	G	1,5	12	2	Site Infrastructure	6	174.943367	31.97978	3	8.423621	1	9	1
208	204927	705417	182.948351	18.944238	0.1	182.848351	G	1,5	12	2	Site Infrastructure	6	174.943367	34.91068	3	7.99994	1	9	1
209	204917	705417	180.188971	15.644481	0.1	180.088971	G	1,5	12	2	Site Infrastructure	6	174.943367	20.56583	3	5.2052	1	9	1
210	204916	705428	179.315603	17.541852	0.6	178.715603	G	1,5	12	2	Site Infrastructure	6	174.943367	20.56583	3	4.372236	1	9	1
211	204907	705427	178.283979	16.331371	0.2	178.03979	G	1,5	12	2	Site Infrastructure	6	175.400437	21.55383	3	3.421542	1	9	1
212	204898	705427	184.002792	14.002792	0.2	183.802792	G	1,5	12	2	Minor Water Feature	6	177.286805	20.65972	3	1.726889	1	9	1
213	204887	705427	178.417805	11.272443	0.1	178.317805	G	1,5	12	2	Minor Water Feature	6	177.286805	12.79845	3	1.1492	1	18	2
214	204887	705438	176.902969	4.987698	0.1	176.802969	G	1,5	12	2	Minor Water Feature	6	177.000774	5.134895	4	-0.097805	1	6	6
215	204889	705447	176.438303	5.273404	0.2	176.043803	G	1,5	12	2	Minor Water Feature	6	176.343959	13.8307	4	-0.099756	1	24	9
216	204887	705458	176.33021	4.003291	0.4	176.53021	G	1,5	12	2	Minor Water Feature	6	176.824841	8.09795	4	0.000753	1	24	3
217	204898	705451	175.092484	6.096679	0.4	174.692484	G	1,5	12	2	Minor Water Feature	6	175.084731	6.50509	4	0.007753	1	24	3
218	204906	705457	174.347889	12.92599	0.4	173.947889	G	1,5	12	2	Site Infrastructure	6	174.769181	2.60272	4	-0.421192	1	12	2
219	204918	705456	173.535034	9.907999	0.3	173.235034	G	1,5	12	2	Site Infrastructure	6	174.951626	2.677706	4	-0.163432	1	12	2
220	204928	705458	173.030543	8.753574	0.2	172.730543	G	1,5	12	2	Site Infrastructure	6	172.999687	1.064814	4	0.00856	1	12	2
221	204928	705447	174.689544	10.010186	0.3	174.494544	G	1,5	12	2	Site Infrastructure	6	173.45441	8.431521	4	1.185134	1	12	4
222	204917	705451	176.937356	17.019718	0.6	176.337356	G	1,5	12	2	Site Infrastructure	6	173.45441	8.431521	4	1.185134	1	12	4
223	204918	705437	177.209488	13.786159	0.3	176.909488	G	1,5	12	2	Site Infrastructure	6	174.943367	12.65096	3	1.992368	1	9	1
224	204917	705447	175.130937	9.962272	0.2	174.930937	G	1,5	12	2	Site Infrastructure	6	174.943367	12.65096					

325	204702	705222	216.68897	0.89864	0.5	216.1889871	R	1.5	1	Site Infrastructure	3	216.700169	2.7387 4	-0.010272	1	12	2
326	204692	705222	216.849341	0.91735	1	216.3493411	R	1.5	1	Site Infrastructure	3	216.859425	0.94165 4	-0.010884	1	12	2
327	204692	705222	217.183389	1.02833	6	216.7863891	R	1.5	6	Site Infrastructure	3	216.73217	0.906126 4	0.454219	1	12	2
328	204692	705486	186.28732	3.45389	0.2	186.043771	R	1.5	0	Site Infrastructure	3	185.99458	8.853846 4	0.249412	1	12	2
329	204688	705503	186.133135	5.65814	4	185.9331351	R	1.5	4	Site Infrastructure	3	186.050991	0.88221 4	0.082144	1	12	2
330	204689	705512	184.532062	9.86919	6	184.4320621	R	1.5	6	Site Infrastructure	3	185.717313	7.69679 4	-1.185251	1	12	2
331	204714	705513	185.120874	8.51208	0.3	185.2108741	R	1.5	0	Site Infrastructure	3	185.130735	13.20797 4	-1.528913	1	9	1
332	204718	705509	183.288045	6.393013	1.4	183.1880453	R	1.5	1	Site Infrastructure	3	183.367146	0.629019 4	-0.069101	1	12	2
333	204718	705495	184.487903	8.631372	0.2	184.2879031	R	1.5	0	Site Infrastructure	3	182.933596	11.50595 3	1.554307	1	9	1
334	204782	705549	174.652238	14.580991	0.1	174.8522381	R	1.5	0	Site Infrastructure	3	174.912184	0.813824 4	0.030378	1	12	2
335	204879	705549	172.525608	14.702509	0.1	172.4256081	R	1.5	0	Site Infrastructure	3	172.424608	0.72466 4	0.097501	1	12	2
336	204800	705549	173.802554	12.031654	6	173.7025541	R	1.5	6	Site Infrastructure	3	173.858705	0.62177 4	-0.056151	1	12	2
337	204790	705531	175.493934	6.491315	4	175.2939341	R	1.5	4	Site Infrastructure	3	175.279756	0.941914 4	-0.085646	1	12	2
338	204786	705531	175.493934	6.033544	0.3	175.2939341	R	1.5	0	Site Infrastructure	3	175.468364	0.55252 4	-0.038002	1	12	2
339	204807	705530	174.134806	7.656807	4	174.0348061	R	1.5	4	Site Infrastructure	3	174.035805	0.951729 4	0.099001	1	12	2
340	204834	705521	174.336462	9.794021	0.2	174.1264621	R	1.5	0	Site Infrastructure	3	174.513053	0.908464 4	-0.186091	1	12	2
341	204808	705514	175.78655	6.458313	0.01	175.786551	R	1.5	0	Site Infrastructure	3	175.786509	0.52071 4	0.020869	1	12	2
342	204815	705504	176.489897	11.81911	0.8	176.4898972	R	1.5	8	Site Infrastructure	3	176.376911	0.638977 4	0.112986	1	12	2
343	204825	705512	174.747035	11.292521	0.2	174.1470351	R	1.5	0	Site Infrastructure	3	174.250024	0.624471 4	0.097011	1	12	2
344	204831	705501	177.170707	13.939476	1.1	176.8707071	R	1.5	1	Site Infrastructure	3	177.164575	0.483752 4	0.020502	1	12	2
345	204822	705495	178.796381	12.883164	1.1	177.6963813	R	1.5	1	Site Infrastructure	3	178.793511	0.981154 4	-0.05713	1	12	2
346	204831	705485	179.533839	5.129	0.8	178.7338392	G	1.5	8	Site Infrastructure	3	179.50118	0.73869 4	0.032659	1	12	2
347	204840	705489	178.45499	8.585879	0.5	177.954991	R	1.5	5	Site Infrastructure	3	178.555301	0.97095 4	-0.100311	1	12	2
348	204847	705481	178.463366	7.538624	0.1	178.3633661	R	1.5	0	Site Infrastructure	3	178.468564	0.502217 4	-0.020488	1	12	2
349	204841	705476	179.55909	6.771552	4	179.359091	G	1.5	4	Site Infrastructure	3	179.563534	0.98352 4	-0.004444	1	12	2
350	204824	705488	182.426409	7.3779	0.3	182.1264091	R	1.5	0	Site Infrastructure	3	182.497571	0.972101 4	-0.071162	1	12	2
351	204808	705483	183.98044	10.079371	0.2	183.690441	R	1.5	0	Site Infrastructure	3	183.956099	1.567803 4	0.233405	1	12	2
352	204794	705458	183.990848	8.740291	6	183.5908481	R	1.5	6	Site Infrastructure	3	183.807813	1.004384 4	0.180395	1	12	2
353	204781	705472	182.685734	7.500011	0.1	182.5857341	R	1.5	0	Site Infrastructure	3	182.614482	0.75561 4	0.069252	1	12	2
354	204761	705460	182.37785	8.458946	0.3	182.3177851	R	1.5	0	Site Infrastructure	3	182.327535	0.52866 4	-0.059148	1	12	2
355	204740	705487	183.27463	9.541356	6	183.174631	R	1.5	6	Site Infrastructure	3	183.323524	0.944865 4	-0.048084	1	12	2
356	204730	705502	182.658884	8.774522	4	182.4588841	R	1.5	4	Site Infrastructure	3	182.790118	1.11775 4	-0.131354	1	12	2
357	205065	705591	145.570824	6.634994	0.2	145.0708241	R	1.5	0	Minor Water Feature	6	144.086612	6.979276 3	1.486212	1	18	2
358	205049	705616	144.898913	6.471265	0.2	144.6989131	R	1.5	0	Minor Water Feature	6	144.086612	46.52887 3	0.112101	1	18	2
359	205032	705619	143.942417	8.967508	6	143.8424171	R	1.5	6	Minor Water Feature	6	143.011167	24.800913 3	0.93125	1	18	2
360	205000	705581	150.321932	10.059557	6	150.1219321	R	1.5	6	Minor Water Feature	6	150.975686	25.1711 3	-0.654664	1	18	2
361	205012	705567	151.652532	10.45591	0.1	151.4525321	R	1.5	0	Minor Water Feature	6	151.645322	44.510717 3	-0.618284	1	18	2
362	205035	705551	151.717457	10.312068	6	151.6174571	R	1.5	6	Minor Water Feature	6	154.047252	66.506 3	-2.329795	1	18	2
363	205010	705526	156.68899	8.207146	0.4	156.288991	R	1.5	0	Roads and Tracks	6	159.527692	30.88776 3	-2.839293	1	9	1
364	204994	705549	161.920201	7.58621	0.1	161.9202011	R	1.5	0	Minor Water Feature	6	156.944984	0.265554 4	0.032884	1	12	2
365	204980	705565	154.728884	9.919123	0.1	154.6288841	R	1.5	0	Minor Water Feature	6	154.994194	10.504317 3	-0.26531	1	18	2
366	204842	705397	193.034316	14.916461	0.3	192.7343161	R	1.5	0	Roads and Tracks	6	198.529382	22.24203 3	-5.495222	1	9	1
367	204823	705377	189.346249	8.491423	0.3	189.2462491	R	1.5	0	Roads and Tracks	6	195.857020	38.49433 3	-4.311124	1	9	1
368	204807	705377	189.951865	7.870833	0.6	189.7518651	R	1.5	6	Site Infrastructure	3	184.78489	32.440483 3	5.166975	1	9	1
369	204771	705367	195.652855	14.307263	0.2	195.4528551	R	1.5	0	Site Infrastructure	3	197.319882	17.188612 3	-1.666827	1	9	1
370	204786	705346	196.273867	7.602002	0.01	196.2738671	R	1.5	0	Site Infrastructure	3	196.369423	0.78447 4	-0.095556	1	12	2
371	204802	705319	202.512142	24.498214	0.1	202.5121421	R	1.5	0	Roads and Tracks	6	202.511742	6.526515 4	-0.000001	1	12	2
372	204780	705309	204.614219	5.97023	4	204.6142191	R	1.5	4	Site Infrastructure	3	208.28895	30.97304 3	-3.374731	1	9	1
373	204762	705323	205.403053	7.700101	0.8	205.2530532	R	1.5	8	Roads and Tracks	6	197.445312	22.150366 3	6.607741	1	9	1
374	204717	705321	205.135436	7.440201	0.8	204.9354361	R	1.5	8	Roads and Tracks	6	195.445312	22.150366 3	6.165	1	9	1
375	204743	705336	204.314656	7.484630	4	203.6146562	R	1.5	4	Roads and Tracks	6	196.970436	20.20706 3	7.34422	1	9	1
376	204732	705327	205.766665	7.390594	0.1	205.6666651	R	1.5	0	Site Infrastructure	3	208.347266	26.46064 3	-2.580001	1	9	1
377	204725	705326	205.766665	7.405236	0.2	205.1906661	R	1.5	0	Site Infrastructure	3	208.347266	27.320217 3	-2.047823	1	9	1
378	204719	705317	208.186001	10.118863	6	208.0860011	R	1.5	6	Site Infrastructure	3	208.347266	28.291974 3	-0.161205	1	9	1
379	204710	705311	209.544304	6.912613	0.2	209.3443041	R	1.5	0	Site Infrastructure	3	209.08938	33.63708 3	0.454924	1	9	1
380	204717	705302	209.89044	7.81771	6.4	209.490441	R	1.5	6	Site Infrastructure	3	209.08938	24.64314 3	0.807365	1	9	1
381	204725	705309	208.953585	8.303446	0.3	208.2935861	R	1.5	0	Site Infrastructure	3	209.08938	18.79668 3	-0.503844	1	9	1
382	204733	705315	207.378355	7.707888	0.2	207.2783551	R	1.5	0	Site Infrastructure	3	208.347266	15.79989 3	-0.968911	1	9	1
383	204740	705321	206.990903	7.687377	0.2	206.8909031	R	1.5	0	Site Infrastructure	3	208.347266	18.314189 3	-2.248263	1	9	1
384	204750	705317	204.717639	7.712914	0.5	204.6176391	R	1.5	0	Site Infrastructure	3	208.347266	17.875207 3	-1.389624	1	9	1
385	204755	705317	205.410573	8.894807	0.3	205.1105731	R	1.5	0	Site Infrastructure	3	208.107263	16.271617 3	-2.69669	1	9	1
386	204748	705312	206.684616	9.273095	0.3	206.3846161	R	1.5	0	Site Infrastructure	3	208.107263	8.78394 4	-1.422647	1	12	2
387	204741	705316	206.422729	9.376441	0.3	206.1227291	R	1.5	0	Site Infrastructure	3	208.347266	3.658963 4	-0.305887	1	12	2
388	204735	705299	209.346121	8.642729	0.4	208.9461211	R	1.5	0	Site Infrastructure	3	209.08938	6.699632 4	0.256741	1	12	2
389	204734	705282	211.705464	6.965467	0.2	211.5054641	R	1.5	0	Site Infrastructure	3	211.364948	3.239324 4	0.340516	1	12	2
390	204726	705292	210.720884	8.990976	0.2	210.5208841	R	1.5	0	Site Infrastructure	3	213.857843	14.33974 3	-0.067039	1	9	1
391	204745	705280	210.720884	7.174474	0.3	210.0208841	R	1.5	0	Site Infrastructure	3	210.969486	0.29751 4	0.032443	1	9	1
392	204749	705297	208.922246	9.637276	0.2	208.7222461	R	1.5	0	Site Infrastructure	3	208.897737	0.162926 4	0.024509	1	12	2
393	204757	705302	207.468165	9.848262	0.2	207.2681651	R	1.5	0	Site Infrastructure	3						

C			2.0
not proven			2.0
slip material			5.0
Receptor		Co-eff	
Roads and Tracks			3.0
Minor Water Feature			6.0
Dwelling			6.0
Major Watercourse			8.0
Site Infrastructure			3.0
Important Habitat			8.0
Receptor Dist.		Co-eff.	
0	10.0		4.0
10	100.0		3.0
100	1000.0		2.0
1000	2000.0		1.0
Receptor Elev.		Co-eff.	
0	10.0		1.0
10	50.0		2.0
50	100.0		3.0
100	200.0		4.0
risk rating normalisation			
0	5.0		1.0
5	15.0		2.0
15	31.0		3.0
31	50.0		4.0
50	100.0		5.0
impact rating normalisation			
0	10.0		1.0
10	20.0		2.0
20	30.0		3.0
30	50.0		4.0
50	100.0		5.0

APPENDIX D – PEAT CORING RECORDS



Background

Peat cores were obtained from selected locations at the proposed An Suidhe Substation and associated infrastructure in March 2022. Cores were advanced in areas of the Site where peat probing had identified the presence of deep peat to characterise the properties of the peatland in accordance with the *Peatland Survey. Guidance on Developments on Peatland (2017)*. The document, which was published jointly by the Scottish Government, Scottish Natural Heritage (NatureScot) and SEPA, defines a consistent sampling methodology to quantify and qualify the peat material on site. It also provides advice on how to publish peat surveys as part of wider site investigations for development management applications, with a particular focus on wind farm developments.

The parameters used to determine the characteristics of the peat materials are outlined below.

i. Surface firmness estimation

An average man standing on one foot applies a pressure to the ground of between 5 and 6 lbs / p.s.i. and this fact is used to estimate the bearing capacity. The following symbols are used to denote the pressure the ground will stand.

Firmness of surface (P)

PO = Surface too soft to walk on

P1 = Surface just passable

P2 = Surface fairly firm

P3 = Surface firm

ii. Observations on the vegetation

The Site has been subject to commercial forestry at varying stages of development with a majority of the Proposed Development in a felled area where long grasses and shrubs now dominate.

iii. Observations on the peat

a. Botanical observations

Botanical observations of peat samples identified that *Carex* species are likely to make up a significant proportion of the organic material in the lower horizons where catotelmic peat is typically found.

b. Degree of humification - von POST SCALE

The degree of humification of peat samples is estimated in the field according to the method devised by the Swedish botanist L. von Post by squeezing a small amount of peat in the hand and the water and / or peat exuded indicates, by its colour and consistency, the degree to which the peat has undergone humification or, more correctly, a type of decomposition which includes breakdown under anaerobic conditions. The von Post scale ranges from 1 to 10, the higher the number the higher the degree of humification. The full scale is as follows:

Von Post Scale (H)	
H1	Completely undecomposed peat free of amorphous material. On squeezing, clear colourless water is pressed out.
H2	Nearly undecomposed peat, free of amorphous material, yielding only yellowish brown water on pressing.



H3	Very slightly decomposed peat, containing a little amorphous material. On squeezing, muddy brown water but no peat passes between the fingers. Residue is not pasty.
H4	Slightly decomposed peat containing some amorphous material. Strongly muddy brown water but no peat passes between the fingers. Residue is somewhat pasty.
H5	Moderately decomposed peat containing a fair amount of amorphous material. Plant structure recognisable though somewhat vague. On squeezing, some peat but mainly muddy water issues. Residue is strongly pasty.
H6	Moderately decomposed peat with a fair amount of amorphous material and indistinct plant structure. On pressing, about one third of the peat passes between the fingers. Residue is strongly pasty, but shows the plant structure more distinctly than in unsqueezed peat.
H7	Strongly decomposed peat with much amorphous material and faintly recognisable plant structure. On squeezing, about one half of the peat is extruded. The water is very dark in colour.
H8	Strongly decomposed peat with much amorphous material and very indistinct plant structure. On squeezing, two thirds of the peat and some water passes between the fingers. Residue consists of plant tissues capable of resisting decomposition (roots, fibres, wood, etc.).
H9	Practically fully decomposed peat with almost no recognisable plant structure. Nearly all the peat squeezed between the fingers as a uniform paste.
H10	Completely decomposed peat with no discernible plant structure. On squeezing, all the peat, without water, passes between the fingers.

iv. Fibre

The fibre content of each peat sample is estimated visually and the amounts of the two types (classified 'fine' or 'coarse') are noted on a scale ranging from 0 to 3 as shown below.

Fine fibres, mainly derived from *Eriophorum spp.* (F)

- F0 = Nil
- F1 = Low content
- F2 = Moderate content
- F3 = High content

Coarse fibres, mainly rootlets (R)

- R0 = Nil
- R1 = Low content
- R2 = Moderate content
- R3 = High content

v. Wood

Wood remains, especially if they are large and resistant, may conceivably cause a certain amount of difficulty during the exploitation of a bog. An attempt is therefore made when sampling to assess the extent of wood. It is estimated on a scale ranging from 0 to 3 as detailed below.

- Wood remains (W)
- W0 = Nil
- W1 = Low content
- W2 = Moderate content

Peat Coring Record

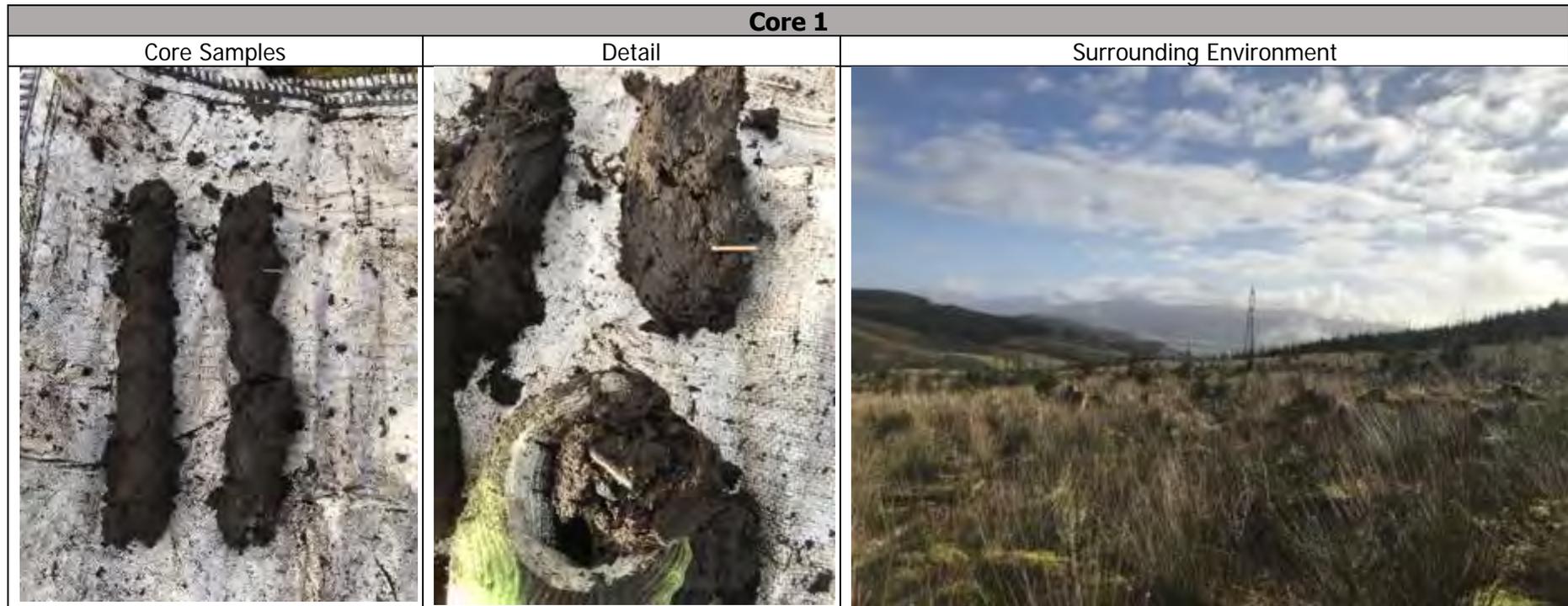


W3 = High content

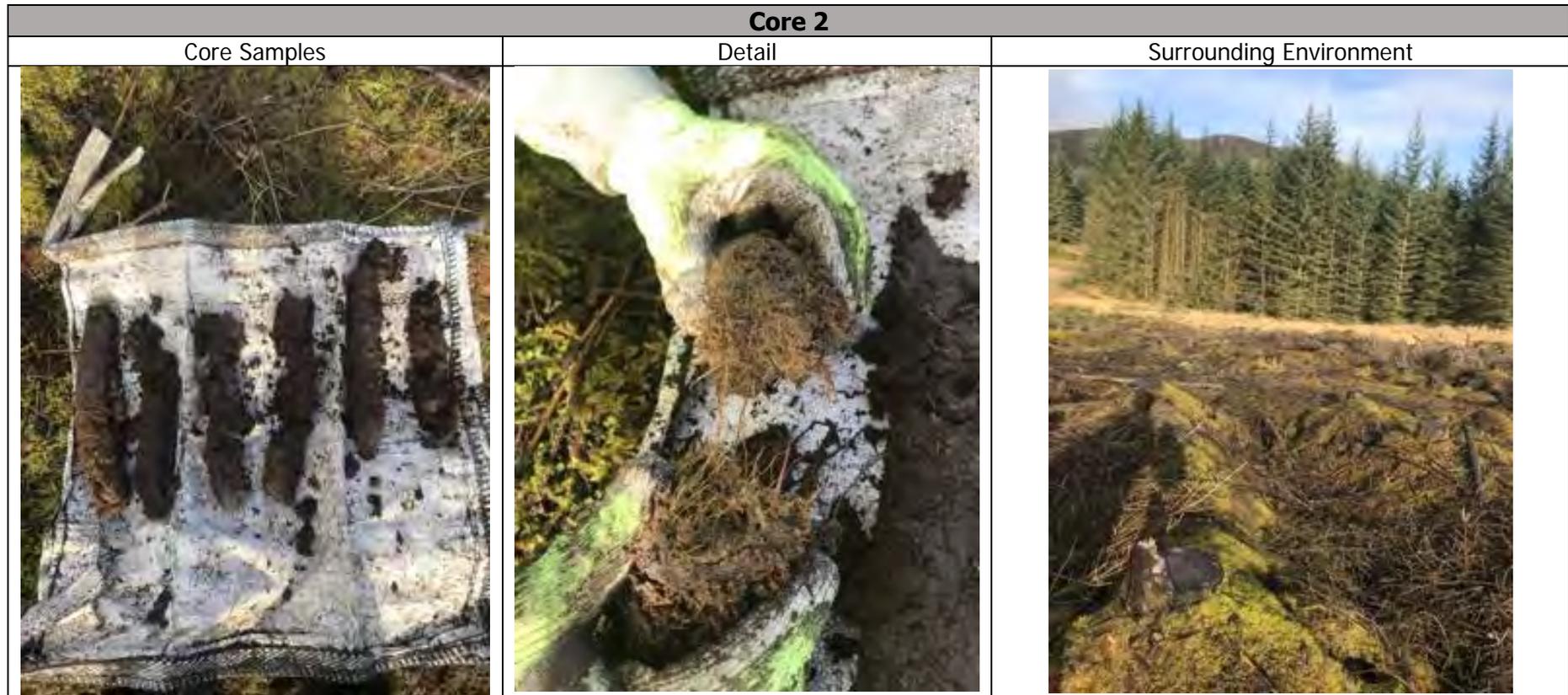
vi. Other observations

When peat is freshly sampled and before it darkens by oxidation, note is taken of its colour, stratification, the presence of visible mineral matter and any other features of interest.

Photographs of the peat cores obtained from Tormsdale along with information relating to the parameters outlined above are presented overleaf with a summary of the information gathered during the peat coring process presented in the main body of text of the Peat Slide Risk Assessment (PSRA)



Location	Depth (m)	Firmness of Surface (P)	Von Post (H)	Fine Fibres (F)	Coarse Fibres (R)	Wood Remains (W)	Other Observations (Colour)
E204781, N705476	0.0-0.5	3	6	1	1	2	Dark Brown
	0.5-1.0		8	1	0	1	Dark Brown



Location	Depth (m)	Firmness of Surface (P)	Von Post (H)	Fine Fibres (F)	Coarse Fibres (R)	Wood Remains (W)	Other Observations (Colour)
	0.0-0.5	2	4	2	3	1	Light Brown
	0.5-1.0		5	1	2	1	Brown
	1.0-1.5		7	1	1	2	Brown
	1.5-2.0		8	1	1	3	Brown
	2.0-2.5		7	0	1	3	Brown
	2.5-3.0		7	0	1	3	Brown

Annex B – Peat Coring Report

