Skye Reinforcement Project

Appendix V2-7.2 – Peat Landslide Hazard and Risk Assessment

Scottish & Southern Electricity Networks (SSEN)

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Making Sustainability Happen

Basis of Report

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Report History

This report presents a revision to the Peat Landslide and Hazard Risk Assessment (PLHRA) which was presented as part of the Section 37 application under the Electricity Act 1989 for the Skye Reinforcement Project (Energy Consents Unit reference: ECU00003395). Specifically, the report has been updated to address comments made by NatureScot and the Scottish Government (by their peat landslide advisors Ironside Farrar) during determination of the application.

The report presents the results of additional peat probing, peat characterisation and auguring, geomorphological mapping, and using this information a reappraisal of the peat landslide hazard associated with all elements of the Proposed Development. Full details are given in the Parts of the report that follow.

A summary of the comments and requests for further information made along with details of where these are addressed in this revised report are made in the table below.

Consultee	Request	Response
NatureScot 22nd May 2023	Specifically in relation to the scale and nature of impacts on the Kinloch and Kyleakin Hills Special Area of Conservation (SAC), an update to the Peat Landslide Hazard Risk Assessment (PLHRA); to include a table similar to Table 1-6 detailing the risk rating for the access tracks on both the Proposed and Alternative Alignments, and an assessment of risk and any further mitigation that may be required.	See Table 6-11 and 6-12.
Scottish Government / Ironside Farrar March 2023	The team undertaking the assessment (including their qualifications and competency) is not included on the PLHRA reporting.	Details given in Part 1.1
	The desk study should be updated with discussion on the other data sets considered including aerial photography and hydrology.	See Part 2.0 and Geomorphology Figures V2-7.2.1 and V6-7.2.1.
	Preparation of a geomorphological map is required for the route.	See Figures V2-7.2.1 and V6-7.2.1.
	Sections 4 and 5 on the mainland have been subject to limited probing ... further information is requested on the actual scope of probing carried out over this section and all results should be incorporated into the PLHRA and associated figures. The Peat depth mapping should be updated with the probing and ground investigation data.	Additional peat probing undertaken in January 2023 following agreement of scope and extent with SEPA. PLHRA has been updated with this data.
	It is not clear whether all permanent/ temporary tracks other ancillary infrastructure associated with the reinforcement project such as borrow pits and temporary construction compounds have been probed in line with the ECUBPG.	Borrow pits and temporary compounds are not part of the application. All elements of the application have been assessed in the PLHRA.

Consultee	Request	Response
	The full scoring calculations for the likelihood assessment should be included in the PLHRA.	See Part 6.0 and Annex A.
	The likelihood assessment requires to be updated to include discussion on likelihood at all infrastructure locations along the route including tracks, borrow pits and construction compounds. The PLHRA should discuss the findings with an update to Table 1-6 providing likelihood summarises and rankings for all these elements.	See Part 6.0, Annex A and Figures V2-7.2.4 and V6-7.2.4.
	Forestry is not included as an input factor in the assessment of likelihood and comment is required on this.	See Table 2-1 and Part 6.0.
	Historical instability has not been discussed within the assessment and there is no scoring coefficients presented or the methodology discussed.	See Table 2-1 and Part 6.0.
	Part 1.8 is confusing and required a review and update.	Reviewed and revised.
	Figure V2-7.2.1 presents peat slide risk at infrastructure on peat >0.5m along the route. The mapping presented areas of negligible to high risk. It is not clear whether this is showing likelihood rather than risk. Further clarification is required.	Reviewed and revised.
	There is no consequence assessment. The PLHRA requires to be updated to include a consequence assessment.	See Part 6.0.
	There is no calculation of peat slide risk along the route.	See Part 6.0, Annex A and Figures V2-7.2.4 and V6-7.2.4.
	Mitigation should be updated based on the risk mapping. Site specific mitigation to reduce risks should be included in the updated PLHRA for all medium and high-risk areas as per the ECUBPG.	See Table 6-11 and 6-12.
	Table 1-6 states that further assessment is required within the medium and high risk areas. Please explain what is meant by this and if this is to involve further intrusive investigation.	Text revised, see Table 6-11 and 6-12.
	Some of the terminology used in the PLHRA for the various risk assessment components appears confused. The terminology used should be in accordance with ECUBPG.	Reviewed and revised throughout.

1.0 Introduction

This Stage 1 Peat Landslide Hazard and Risk Assessment (PLHRA) has been prepared by SLR Consulting Ltd (SLR) and is an update of the PLHRA which was submitted as Appendix V2-7.2: PLHRA of the Environmental Impact Assessment (EIA) Report, for the Skye Reinforcement Project[1] (the Proposed Development).

Specifically, this report presents the results of additional peat depth probing and peat landslide hazard analysis which has been undertaken to address comments provided following an audit of the original PLHRA[2] by Ironside Farrar (IF) on behalf of the Energy Consents Unit (ECU) following submission of the EIA Report.

The purpose of this report is to consider the potential risk of peat landslides occurring within the vicinity of the Proposed Development (also referred to in this report as 'the Site') such that suitable controls and appropriate methodologies can be employed during the construction and operation of the Proposed Development to mitigate against these risks. This report presents the findings of the peat slide hazard and risk assessment based on the data obtained by intrusive site investigation (drilling) at proposed tower locations and peat depth probing surveys which were undertaken by SLR in November/December 2021, January/February 2022, and January and April 2023.

The methods adopted for the assessment follow the best practice guidance[3] issued by the Scottish Executive (now the Scottish Government) for investigation, assessment and reporting for Proposed Electricity Generation Developments in peat areas.

This report should be read in conjunction with the site-specific Peat Management Plan (PMP) (see **Appendix V2-7.3**) and **Volume 2, Chapter 7: Geology and Soils** of the EIA Report. This report includes consideration of the Alternative Alignment within Section 3 of the project, which is assessed within **Volume 6, Chapter 7: Geology and Soils** of the EIA Report.

This PHLRA will be further developed during the detailed design process and will form part of the appointed Principal Contractor's Construction Environmental Management Plan (CEMP) for the Proposed Development.

1.1 The Project Team

The assessment work has been undertaken by a team comprising experienced, geologists, consultants and engineers with much experience in undertaking peat and geotechnical assessments for renewable energy and infrastructure developments. All of whom have had formal training (e.g. BSc, MSc, CEng and MEng) in geology, geotechnics and engineering.

The team was led by Gordon Robb (BSc (Hons), MSc, MBA, C.WEM, FCIWEM) who has more than 30 years' consultancy experience and specialises in the assessment of soils, geology and water for renewable power projects in Scotland. Gordon has worked on over 100 wind farm projects and numerous electrical infrastructure projects. He is also a contributing author to Scottish Government guidance relating to the assessment of peat on wind farms.

1 Skye Reinforcement Project : EIA Report – Volume 1 – Chapter 3 Project Description. June 2022.

2 Skye Reinforcement Project : EIA Report – Volume 5 – Appendix V2-7.2 – Peat Landslide Hazard and Risk Assessment. September 2022.

3 Scottish Government (April 2017) Peat Landslide Hazard and Risk Assessment: Best Practice Guide for Proposed Electricity Generation Developments (Second Edition).

1.2 Background

The importance of assessing the stability of peat deposits in relation to energy developments came to the fore as a result of peat failures during the construction of Derrybrien[4] Windfarm in Ireland in 2003. Although no fatalities were associated with these failures, there was a significant environmental impact. Energy infrastructure developments constructed in high moorland areas can 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.

1.3 Site Location and Description

The Proposed Development is comprised of approximately 160km of 132 kV transmission connections to be constructed between Ardmore Substation in the north of the Isle of Skye to Fort Augustus Substation. This includes 110km of new double circuit 132 kV Overhead Line (OHL) on steel lattice towers, 26km of new single circuit 132 kV OHL on trident wood poles (H poles), temporary diversion of the existing 132 kV OHL at Inchlaggan to facilitate construction of the new OHL and approximately 24.25km of new double circuit 132 kV underground cables. The underground cables are proposed within two distinct areas of the Proposed Development: in Section 2 within the vicinity of the Cuillins and in Section 6 between Loch Lundie and Fort Augustus Substation.

The Proposed Development also includes construction of temporary and permanent access tracks, public road upgrades, cable sealing compounds and the clearance of forestry and vegetation.

The Proposed Development is split into 7 geographical sections:

- Section 0 - Ardmore Substation to Edinbane Substation
- Section 1 – Edinbane to North of Sligachan
- Section 2 – North of Sligachan to Broadford
- Section 3 – Broadford to Kyle Rhea (including Alternative Alignment)
- Section 4 – Kyle Rhea to Loch Cuaich
- Section 5 – Loch Cuaich to Invergarry
- Section 6 – Invergarry to Fort Augustus

1.4 Scope and Objectives of Report

The purpose of this report is to identify those parts of the Proposed Development that are naturally susceptible to a higher risk of instability so that they can be avoided or accommodated. 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 Proposed Development. The main objective is to assess the potential peat stability throughout 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:

4 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

- a desk based review of available reports which include geological, hydrological and topographical information;
- several phases of peat depth probing surveys which were undertaken by SLR in November/ December 2021, January/February 2022, January and April 2023;
- intrusive site investigation (drilling) to inform the proposed foundation design at the proposed tower locations;
- geomorphological mapping to identify existing 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;
- 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 used by the Principal Contractor (and to be included in the CEMP) to minimise the risk of peat instability occurring at the Development; and
- provide recommendations for further work or specific construction methodologies to suit the ground conditions 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 the proposed I development to follow a very carefully worded and developed CEMP which uses many of the recommendations of the PLHRA.

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

- construction of access tracks;
- excavation and stockpiling of material associated with tower foundations;
- excavation and installation of cable and cable sealing end compounds;
- construction of hardstanding areas; 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 real extent of possible impact.

1.5 Methodology

The risk assessment is based on ground models developed using a Geographical Information System (GIS). Numerical analysis was undertaken in which coefficients were allocated to each of the factors influencing peat stability and their impact on possible receptors. This approach was developed in accordance with the guidelines on PLHRA published by the Scottish Government[3] 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 Desk Study

Desktop data was reviewed by SLR, including aerial photographs and Ordnance Survey (OS) 1:25,000 scale mapping which included a 5m Digital Terrain Model (DTM). The aerial photography consisted of ortho-rectified colour images; no stereoscopic aerial photographs were available.

The desk study methodology included a review of the following:

- preliminary and final layout of Proposed Development;
- topographical surveys;
- available aerial photography;
- land use;
- historical and current geological maps and publications;
- hydrology and hydrogeology;
- peat stability issues in the surrounding area; and
- potential impact receptors.

This desktop assessment also included review of the following:

- NatureScot Environment map viewer[5];
- British Geological Survey (BGS) Geoindex mapping[6];
- NatureScot SiteLink[7];
- Scotland's Environment online viewer[8];
- The Coal Authority Interactive Map[9];
- Zetica UXO Risk Maps[10]; and
- current and historical Ordnance Survey maps.

Investigation reports were produced by Card Geotechnics Ltd following SI works across large parts of the alignment. These were used to compliment the data gathered as part of the peat probing campaign. SLR reviewed reports undertaken in Sections 1, 2, 3, 4, 5 and 6.

2.1 Site Walkover

Detailed site walkover surveys were initially undertaken by SLR in October 2020 and comprised reconnaissance visits of the entire length of the alignment either walked or driven. The walkover survey was used to scope the programme of peat depth probing which was then undertaken in a series of probing campaigns by experienced SLR staff.

5 Scottish Natural Heritage (SNH), The James Hutton Institute and Scottish Government., (2016). available at: www.environment.scotland.gov.uk [Accessed 22 March 2022]

6 British Geological Survey (BGS) Online Viewer/Geoindex website, available at: http://mapapps.bgs.ac.uk/geologyofbritain/home.html ; http://www.bgs.ac.uk/geoindex / [Accessed 22 March 2022]

7 NatureScot SiteLink, available at: https://sitelink.nature.scot/about [Accessed 22 March 2022]

8 Scotlands Environment webmap, available at https://map.environment.gov.scot/sewebmap/, available at: https://magic.defra.gov.uk/ [Accessed 22 March 2022]

9 Coal Authority (2022), available at: https://mapapps2.bgs.ac.uk/coalauthority/home.html [Accessed 22 March 2022]

10 Zetica UXO (2022), available at: https://zeticauxo.com/downloads-and-resources/risk-maps/ [Accessed 22 March 2022]

2.2 Topographical Surveys

All of the surveys were based on 5m DTM data which was used to determine slopes across the Proposed Development and to determine slope coefficient (score) factors at each probe hole location. The development has been characterised into slope classes and a slope plan produced to identify slope areas where potential gradients are more or less susceptible to slope failure mechanisms.

2.3 Geology

2.3.1 Superficial Geology

The superficial geology across the north-western part of the Isle of Skye comprises areas of alluvium, peat and till deposits (Section 0 and Section 1). Sporadic areas within the study area are mapped without superficial deposits indicating that bedrock is at or near the surface. Alluvium is generally associated with the valleys of rivers and streams. The Varragill and Drynoch Rivers are also associated with Hummocky (moundy) Glacial Deposits. Between Loch Sligachan and Broadford Bay (Section 2) there is an absence of mapped superficial deposits across much of the area indicating the bedrock is at or near surface. Between Broadford and Kyle Rhea (Section 3) the coastal areas are mapped as marine deposits, while the upland areas around Beinne na Greine and other summits comprise sporadic till and moranic deposits or bedrock at the surface.

On the mainland the published mapping indicates that much of the area (Section 4, Section 5 and Section 6) is absent of superficial deposits and bedrock is marked at or near the surface. Where present the superficial geology comprise Quaternary age till and morainic deposits, hummocky glacial deposits, isolated pockets of peat and alluvium associated with the river valleys.

The Carbon and Peatland Map[11] shows the distribution of carbon and peatland classes across the whole of Scotland. The classification ranges from Class 1 and 2 Nationally Important carbon rich soils to Class 4 and 5 predominantly mineral soils with some peat. It is a coarse method for classifying peat areas and is used as a guide to classify peat, which can be further modified by site specific mapping and assessment. The Map records the north and western part of Skye as Class 1 peatland, the central part of the island is generally recorded as Class 3, while the eastern part of the island, where peat is mapped, records a variety of classes from Class 1 to 5. On the mainland where peat is mapped, it is generally Class 2 or 5, with pockets and isolated areas of other peat classes.

2.3.2 Bedrock Geology

The Isle of Skye can be divided in to three distinct geological areas. The north of Skye including the Waternish Peninsula (Sections 0 and Section 1) comprises the laterally extensive and thick Paleogene plateau type lava fields and pyroclastic rocks, overlying Jurassic sedimentary rocks which crop out along the east coast. The Skye Lava Group mainly comprise basalt and basic tuffs.

The central portion of the island is dominated by Skye Western and Eastern Red Hills Centre, the last focal point of volcanic activity preserved on Skye (Section 2). These, with the Cullins Hills, give rise to the mountainous region in the centre of Skye. The Red Hills are formed by Lower Tertiary (Paleogene) intrusive rocks dominated by gabbro and granite. The

11 NatureScot, (2016) Carbon and Peatland 2016 map. Available from: http://map.environment.gov.scot/soil_maps/ Scottish Government, 2016, [Last accessed 22 March 2022]

igneous rocks have been intruded into the older Torridon and Lias Group sedimentary rocks, which still crop out in some locations.

The Sleat Peninsula and the eastern part of the island comprises Neoproterozoic sedimentary rocks of the Torridon and Sleat groups with Paleaogene igneous intrusions (Section 3). These units lie to the west of the Moine Thrust, which trends northeast southwest through the Sound of Sleat and the Sleat Peninsula and have been subject to faulting and folding.

East of the Moine fault (Section 4), Archaean age basement gneiss inliers (the Lewisian Complex) overlain are by younger Morar and Glenfinnian psammites and pelites. The deposits typically follow a west to east younging pattern. Further southeast between Loch Quioch, Invergarry and Fort Augustus (Section 5 and Section 6) the psammites of the Loch Eil Group (Moine Supergroup) is the predominant geological unit with lithologies of the West Highland Granite Gneiss Intrusion and of the Argyll and Northern Highlands Granitic Suite. The region has been subject to significant metamorphism, thrusting and folding during tectonic and seismic activity during the Ordovician-Silurian Caledonian Orogeny. There are a range of igneous intrusions and dykes intersecting the older meta-sedimentary rocks.

2.4 Mining and Quarrying

The BGS Coal Authority Viewer indicates that there are no coal mining reporting areas throughout the proposed alignment.

BGS Online Geoindex indicates that there are various quarries and pits located within close proximity to the Proposed Development in areas of Sections 0, 2, 4 and 5:

- In Section 0, there are numerous gravel pits present alongside the alignment from Ardmore Substation to Dunvegan. In addition, there is Waternish Quarry present adjacent to the alignment near Hallin.
- In Section 2, disused Sligachan Quarry is present near Loch Sligachan. In addition, there are multiple gravel pits present alongside the Proposed Development near Loch Ainort and Luib.
- In Section 4, Teanga Narn Mart Quarry is present near Glenelg and Loch Quoich Dam is situated north of Loch Quoich alongside the alignment. In addition, there are other pits present alongside this section of the alignment.
- Throughout Section 5, there is Poulary Pit present near Glen Garry adjacent to the Proposed Development alignment and Inchlaggan Pit at Inchlaggan present near the alignment.

2.5 Hydrogeology

The SEPA Water Classification Hub indicates that the majority of Sections 0 and 1 of the Proposed Development are underlain by the Skye North groundwater body (ID: 150688), which has an overall classified status of ‘good’. These areas are underlain by unnamed Paleogene extrusive rocks which are characterised as low productivity aquifers. This indicates that small amounts of groundwater are present in the near surface weathered zones and secondary fractures, with up to 2l/sec being fed from rare springs.

The majority of Sections 2 and 3 are underlain by the Skye South groundwater body (ID: 150675), which has an overall classified status of ‘good’ and are underlain by unnamed extrusive rocks, unnamed intrusive rocks and various groups such as Sleat Group, Torridon Group, Durness Group and Lias Group. The majority of these aquifers are classed as low productivity, yielding small amounts of groundwater. The Durness Group, underlying a localised area of the Proposed Development near Broadford Substation, is classed as a moderately productive aquifer, comprises dolomitised limestone.

The majority of Section 4 is underlain by the Wester Ross, Assynt and Kintail groundwater body (ID: 150700), which has an overall classified status of 'good' and are underlain by the Lewisian Complex and the Morar Group, which are classed as low productivity aquifers which accumulate small amounts of groundwater in near surface weathered zones and secondary fractures.

Areas of Section 4, Section 5 and 6 are underlain by the Northern Highlands groundwater body (ID: 150701), which has an overall classified status of 'good' and are underlain by the Glenfinnan Group, Loch Eil Group, and Unnamed Igneous Intrusions which are all classified as low productivity aquifers with small amounts of groundwater present near surface weathered zones and secondary fractures.

2.6 Geomorphology and Historic Land Slips

The site surveys, aerial photographs and DTM data were used to identify the major geomorphological features such as the breaks of slope and landslips. Where required these were inspected during site visits and more detailed assessment was undertaken.

The geomorphological features identified from desk-based review and site walkovers are detailed on **Figure V2-7.2.1** and **Figure V6-7.2.1**.

Aerial photography using Google Earth was reviewed using images from 2023 and dating back to 1984. Interpretation of available aerial photographs was undertaken to assess and identify evidence of historic peat instability. The photographs were examined using various techniques to highlight features of interest, such as:

- possible extension and/or compression features;
- areas of historic failure scars and debris;
- evidence of soil creep;
- areas with apparently poor drainage;
- areas with concentrations of surface drainage networks;
- steeply incised stream cuttings within peat deposits; and
- areas with peat drift recorded on steep slopes.

Table 2-1 details the geomorphology across the different sections of the Proposed Development.

Table 2-1: Geomorphology Summary

LOCATION	DETAILS
SECTION 0	
Map 1: Ardmore Bay (Skye)	• **Peat**: BGS mapped area as raised marine deposits and glacial till. No peatland vegetation mapped – mineral soils only (Carbon and Peatland Maps). Near Hallin, alignment crosses a small area of Class 1 and Class 5 peat soil at Beinn na Mointich and where the alignment follows alongside an area of forestry and felled forestry towards Lusta. BGS has mapped area as predominantly glacial till with small areas of peat and exposed bedrock. • **Peat Hagging**: None identified in the immediate area. • **Exposed bedrock**: No major areas of exposed outcrop. • **Forestry**: Area of forestry present alongside the alignment southwest of Hallin. • **Drainage**: Rivers and minor streams present, discharging to Loch Bay.

LOCATION	DETAILS
	• **Topography**: The alignment is situated along hillsides and relatively gentle slopes. Slightly steeper gradients near Trumpan with lower gradients out towards Halistra. • **Evidence of Peat Instability** - None
Map 2: Lusta	• **Peat**: Alignment initially crosses Class 5 peat soil, small pockets of Class 1 peat, and areas of mineral soils. Towards the south of this section, the alignment crosses Class 1 peatlands. BGS mapped this section as predominantly peat and glacial till. • **Peat Hagging**: None identified in the immediate area. • **Exposed Bedrock**: No major areas of exposed outcrop. • **Forestry**: No forestry on or directly adjacent to the alignment. • **Drainage**: The alignment crosses rivers, such as Allt Chaim, and minor streams present discharging to Loch Bay. • **Topography**: The alignment is situated on flatter areas and along hillsides, however these are on relatively gentle slopes. Small section south of Lusta situated on steeper slope. • **Evidence of Peat Instability** - None
Map 3: Dunvegan	• **Peat**: This section of the alignment predominantly crosses Class 1 peat, with small pockets of Class 2, 3 and 5 peat, and mineral soils. Area of deep Class 1 peat identified in north of section. BGS mapped this section as predominantly peat, glacial till, and localised alluvium alongside rivers. • **Peat Hagging**: None identified in the immediate area. • **Exposed Bedrock**: Towards north of this section, there are some areas of localised exposed bedrock. • **Forestry**: Small area of forestry present in the north of this section and the south of this section to the southeast of Dunvegan Substation. • **Drainage**: Alignment crosses minor streams and rivers such as Rockshill River, which flows southwest discharging into Pool Roag, and Akteil Burn, which joins with Caroy River, later discharging in the south at Loch Caroy. • **Topography**: This section of the alignment is predominantly situated on very gentle hillsides and flatter expanses. • **Evidence of Peat Instability** - None
Map 4: Edinbane	• **Peat**: Section mapped as predominantly mineral soils, with areas of Class 1 and Class 5 peat. BGS mapped area as predominantly peat and glacial till. • **Peat Hagging**: None identified in the immediate area. • **Exposed Bedrock**: Localised minor outcrops of bedrock throughout this section. • **Forestry**: Mid-section of alignment near Edinbane Substation crosses an area of forestry, although it looks like most of the alignment buffer is situated in an opening within the forestry due to the existing OHL. There is also a minor area of forestry near the alignment to the north of Loch Caroy in the western area of this section. • **Drainage**: Alignment crosses multiple rivers and streams draining to Loch Caroy. In addition, the alignment runs parallel to Rageary Burn. • **Topography**: This section of alignment is located along relatively flat expanses and gentle slopes. • **Evidence of Peat Instability** - None
SECTION 1	

LOCATION	DETAILS
Map 4: Edinbane	• **Peat**: Class 1 and 5 Peat and mineral soils present. BGS mapped area as peat and glacial till. Some areas of deeper peat identified along flatter sections of the alignment. • **Peat Hagging**: None identified in the immediate area. • **Exposed Bedrock**: Localised areas of exposed bedrock to the southeast of Edinbane Substation in the open areas. • **Forestry**: A section of the alignment crosses area of forestry in the southeast, some of which is felled. • **Drainage**: The alignment crosses numerous minor rivers and streams in this area, draining to Loch Caroy. • **Topography**: This section is situated on a relatively gentle incline. • **Evidence of Peat Instability** - None
Map 5: Loch Connan	• **Peat**: This area of the section is mapped as Class 1 Peat. BGS has also mapped this area as peat with sections of unknown superficial deposits. • **Peat Hagging**: There are areas of peat hagging along this section, particularly in the area east of Loch Connan. There is also an area of peat hagging to the east of the exposed section of OHL trending northwest-southeast between areas of forestry. • **Exposed Bedrock**: There are localised areas of exposed bedrock throughout this section. • **Forestry**: Towards southeast of this section, alignment crosses areas of forestry. • **Drainage**: The alignment crosses numerous rivers and streams in this area. • **Topography**: This section is on relatively flat expanses and gentle hillsides, therefore peat slide risk is minimal. Area of section heading southeast is situated towards base of slope, however, there is thin peat recorded in this area. • **Evidence of Peat Instability** - None **Access Tracks outwith OHL alignment (track north of Loch Connan)** • **Peat:** Mapped Class 1 and 5 peat is present alongside existing track. • **Peat Hagging:** There is an area of peat hagging present in the eastern section of this track, to the east and northeast of Loch Connan. • **Exposed Bedrock:** Localised areas of exposed bedrock, predominantly throughout forested area. • **Forestry:** The proposed wider extents of the existing track crosscut the area of forestry to the north and west of Loch Connan. • **Drainage:** There is one minor river that crosses the track, draining to Loch Connan. • **Topography:** Section alongside track is relatively flat with gentle slopes. • **Evidence of Peat Instability** - None **Access Track outwith OHL alignment (including permanent access track further east off the B885)** • **Peat:** Mapped Class 1 and 2 peat present along this proposed access track. • **Peat Hagging**: None identified in the immediate area. • **Exposed Bedrock**: Localised areas of exposed bedrock present. • **Forestry:** Proposed track extents crosses areas of forestry present to the south of the B885.

LOCATION	DETAILS
	• **Drainage:** Minor streams crosscut proposed tracks. • **Topography**: Flatter expanses with gentle incline. • **Evidence of Peat Instability** - None
Map 6: Glen Vidigill	• **Peat:** This area of OHL is predominantly mapped as Class 5 Peat with areas of Class 1. • **Peat Hagging:** None identified in the immediate area. • **Exposed Bedrock**: Localised areas of bedrock outcrops identified, particularly in the north of the forestry and in the exposed area to the south of the forestry. • **Forestry:** Extents of OHL situated in an area of forestry. • **Drainage:** A couple of minor rivers crosscut this area of the alignment. • **Topography:** Section situated on hillsides with relatively gentle slopes. • **Evidence of Peat Instability** - None **Access Track outwith OHL alignment** • **Peat:** Predominantly Class 5 Peat with areas of Class 1, 3 and mineral soils. • **Peat Hagging**: None identified in the immediate area. • **Exposed Bedrock**: Areas of localised outcrops alongside existing access track, predominantly in the length of track outwith the forested area. • **Forestry**: Track is predominantly located within the area of forestry. • **Drainage:** Existing track crosses multiple rivers and streams present in this area. • **Topography:** Track is partially situated on the side of river valley outwith the area of forestry and on a hillside with relatively gentle slopes uphill of the access tracks. • **Evidence of Peat Instability** - None
Map 7: Glen Varragill	• **Peat:** Predominantly Class 1 Peat with areas of Class 5. Pockets of deep peat throughout this section, particularly in flatter areas near Meall an Fhuarain. • **Peat Hagging:** None identified in the immediate area. • **Exposed Bedrock:** No major areas of exposed outcrop. • **Forestry:** The alignment crosses areas of forestry present towards the end of Section 1. • **Drainage:** Alignment crosses multiple minor rivers and streams in this area. • **Topography:** OHL situated on relatively gentle slopes, downhill of steeper areas in some cases. • **Evidence of Peat Instability** - None
SECTION 2	
Map 8: Sconser and Loch Sligachan	• **Peat:** This area is mapped as Class 1 Peat, Class 3 Peat and mineral soils.. Localised area of superficials near Loch Sligachan, mapped by BGS as marine deposits (silt and clay). Some areas of peat mapped by BGS as hummocky glacial deposits • **Peat Hagging:** None identified in the immediate area. • **Exposed Bedrock:** There are minor exposed bedrock outcrops throughout this section of the alignment. • **Forestry**: Area of forestry located near the alignment, to the east of the OHL, east of Sconser. • **Drainage**: The alignment crosses multiple minor rivers and streams, predominantly draining to Loch Sligachan.

LOCATION	DETAILS
	• **Topography:** OHL situated on gentle hillsides and flatter expanses. Steeper hillsides present, however, there is shallow peat uphill from the Proposed Development in this area, hence peat slide risk is lower. • **Evidence of Peat Instability** - None
Map 9: Loch Ainort	• **Peat:** This area is predominantly mapped as Class 1 and 3 Peat, with localised areas of Class 2, 5, and mineral soils. • **Peat Hagging:** Area of peat hagging present to the southeast of Luib. • **Exposed Bedrock**: There are minor exposed bedrock outcrops throughout this section of the alignment. • **Forestry**: No forestry present along this area of the alignment. • **Drainage:** Alignment crosses multiple minor rivers and streams, predominantly draining to Loch Ainort. • **Topography:** OHL situated on gentle hillsides and flatter expanses. • **Evidence of Peat Instability** - None
Map 10: Broadford	• **Peat:** This area is predominantly mapped as Class 2 and 5 Peat, with localised areas of Class 3 and mineral soils. Areas of deeper peat identified near Broadford. • **Peat Hagging:** None identified in the immediate area. • **Exposed Bedrock:** There are frequent exposures of bedrock at surface throughout this section of the alignment. • **Forestry:** Alignment crosses areas of forestry west and southwest of Broadford. • **Drainage:** Alignment crosses multiple minor rivers and streams, predominantly draining to Loch na Cairidh. • **Topography**: OHL situated on gentle hillsides and flatter expanses. • **Evidence of Peat Instability** - None
SECTION 3	
Map 10: Broadford	• **Peat:** Predominantly Class 2 and 5 Peat, with localised areas of Class 3 and mineral soils. Areas of deeper peat identified near Broadford. • **Peat Hagging:** None identified in the immediate area. • **Exposed Bedrock:** Minor areas of bedrock exposed at surface. • **Forestry:** Alignment crosses areas of forestry west and southwest of Broadford • **Drainage:** Alignment crosses multiple minor rivers and streams, predominantly draining to Loch na Cairidh. • **Topography:** OHL situated on gentle hillsides and flatter expanses. • **Evidence of Peat Instability** - None
Map 11: Kyleakin	• **Peat:** Predominantly mapped as Class 1 Peat in open areas and Class 5 Peat in the areas of forestry. • **Peat Hagging:** Localised area of peat hagging identified in the western area of this section. • **Exposed Bedrock:** Frequent bedrock outcrops along exposed areas of this section. • **Forestry:** OHL alignment proposed through forestry and felled forestry for the majority of this section. • **Drainage:** The alignment crosses multiple minor rivers and streams throughout this area. • **Topography:** Predominantly flat expanses and gentle hillsides.

LOCATION	DETAILS
	• **Evidence of Peat Instability** - None
Map 12: Kyleakin	• **Peat:** This area is predominantly mapped as mineral soils. There is an area of mapped Class 5 Peat in the west of this section and areas of Class 4 and 5 in the east. There are also minor areas of mapped Class 1 and 3 Peat along this section. BGS has mapped section as predominantly no superficial deposits and till morainic deposits (diamicton, sand, gravel). • **Peat Hagging:** None identified in the immediate area. • **Exposed Bedrock:** Frequent exposures of bedrock, predominantly in the east of this section of the alignment. • **Forestry:** Frequent areas of forestry and felled forestry located within the Proposed Development and alongside the alignment. • **Drainage:** The alignment crosses multiple minor rivers and streams throughout this area, predominantly draining to Loch Alsh in the north. • **Topography:** Steeper sloped present in this area, however, predominantly exposed bedrock and Class 3 peat mapped uphill from the alignment. • **Evidence of Peat Instability** - None
SECTION 4	
Map 13: Glenelg	• **Peat:** There is predominantly Class 5 peat mapped along this section, especially in the west. There are localised areas of Class 5, Class 2 peat and mineral soils present along the remainder of this section. BGS has mapped this area as till and morainic deposits, no superficials and localised areas of till and marine deposits near Glenmore River. • **Peat Hagging:** None identified in the immediate area. • **Exposed Bedrock:** Minor exposures of bedrock outcrops along this section. • **Forestry:** Area of forestry present in northwest of this section. There is an area of natural woodland near Glenmore River. • **Drainage:** The alignment crosses multiple rivers and minor streams, predominantly draining to Kyle Rhea in the west. Glenmore River is present near the south of this section. • **Topography:** Alignment is located along hillsides, with slightly steeper sections near Glenmore River. • **Evidence of Peat Instability** - None
Map 14: Gleann Beag	• **Peat:** Predominantly Class 2 and 5 Peat mapped in this section with areas of mineral soils. • **Peat Hagging:** None identified in the immediate area. • **Exposed Bedrock**: Frequent exposures of bedrock in the central areas of this section, near Am Platah Mor and Loch Beinn Chaoinich. • **Forestry:** Areas of woodland and forestry present in the north and south of this section. • **Drainage:** The alignment crosses a couple of minor streams and rivers along this section. • **Topography:** Relatively gentle hillsides, flatter expanses and some steeper areas near Gleann Beag. • **Evidence of Peat Instability** - None **Access tracks:** • **Peat:** These areas are predominantly mapped as Class 2 and 3 Peat and mineral soils.

LOCATION	DETAILS
	• **Peat Hagging:** None identified in the immediate area. • **Exposed Bedrock:** Frequent exposures of bedrock in the central areas of this section, near Am Platah Mor and Loch Beinn Chaoinich. Minor exposures of bedrock identified in other areas in this section. • **Forestry:** Track to the west of the OHL is situated through forestry and felled forestry. • **Drainage:** The proposed tracks crosscut a couple of minor streams and rivers along this section. • **Topography:** Tracks situated on undulating ground with steeper slopes in areas such as Glen More. • **Evidence of Peat Instability** - None
Map 15: Gleann Dubh Lochain	• **Peat:** This area is predominantly mapped as Class 2 Peat. Localised areas of Class 4 and 5 Peat present. • **Peat Hagging:** None identified in the immediate area. • **Exposed Bedrock:** Frequent exposures of bedrock throughout this area. • **Forestry:** Area of forestry present alongside the OHL alignment near the south of this section. • **Drainage:** The OHL alignment and tracks crosscut multiple minor rivers and streams in this area. • **Topography:** OHL and tracks proposed on flatter expanses in Allt Ghleann Aoidhdailean river valley, and flatter exposed areas near Kinlochhourn. • **Evidence of Peat Instability** - None
Map 16: Kinloch Hourn	• **Peat:** This area is predominantly mapped as Class 2 Peat, with localised areas of Class 4 and 5 Peat and mineral soils mapped. • **Peat Hagging:** None identified in the immediate area. • **Exposed Bedrock:** There are frequent exposures of bedrock at surface along this section of the alignment, particularly in the east near Loch Coire. • **Forestry:** Alignment crosses and is adjacent to minor areas of forestry present along this section of the alignment. • **Drainage:** Alignment crosses multiple rivers and streams, predominantly draining to Loch Hourn. • **Topography:** OHL located along gentle and steep hillsides with occasional flatter expanses. Predominantly soils and bedrock uphill of steeper sections. • **Evidence of Peat Instability** - None
Map 17: Loch Cuaich	• **Peat:** Predominantly Class 2 and 5 Peat mapped in this areas with localised zones of Class 3 Peat. BGS has mapped superficial deposits in this area as hummocky glacial deposits. • **Peat Hagging:** None identified in the immediate area. • **Exposed Bedrock:** Frequent exposures of bedrock throughout this area. • **Forestry:** Localised areas of forestry along alignment, particularly near Loch Quoich bridge. • **Drainage:** Alignment crosses multiple rivers and minor streams, draining to Loch Quoich south of the alignment. • **Topography:** OHL is situated on gentle hillsides with steeper sections where soils and exposed bedrock are dominant. • **Evidence of Peat Instability** - None
SECTION 5	

LOCATION	DETAILS
Map 18: Loch Poulary	• **Peat:** This area is predominantly mapped as Class 2 Peat with areas of Class 1 and Class 5 in east. • **Peat Hagging:** None identified in the immediate area. • **Exposed Bedrock:** Minor exposures of bedrock outcrops along alignment. • **Forestry:** Localised areas of forestry and felled forestry in centre and east of this section near Loch Poulary • **Drainage:** The alignment crosses multiple rivers and minor streams, draining to Loch Poulary south of the OHL. • **Topography:** Alignment located on gentle hillsides. • **Evidence of Peat Instability** - None
Map 19: Glen Garry	• **Peat**: This section is predominantly mapped as Class 5 Peat (western areas near Inchlaggan) and mineral soils (east), with a localised area of Class 3 Soil. • **Peat Hagging**: None identified in the immediate area. • **Exposed Bedrock**: Minor exposures of bedrock outcrops along alignment. • **Forestry**: Extensive areas of forestry and felled forestry along this section of the alignment, particularly in the western and central areas of the section. • **Drainage**: The alignment crosses multiple minor rivers and streams draining to Loch Garry south of the OHL. • **Topography**: Alignment located on gentle hillsides. • **Evidence of Peat Instability** - None
Map 20: Loch Garry	• **Peat:** In the west and central areas there is mapped Class 5 Peat and mineral soils. In the east, there is Class 2 Peat with localised pockets of Class 1. BGS has mapped this section as hummocky glacial deposits with pockets of peat, and no recorded superficials in some areas. • **Peat Hagging:** None identified in the immediate area. • **Exposed Bedrock:** No major areas of exposed outcrop. • **Forestry:** Extensive areas of forestry and felled forestry along this section of the alignment, particularly in the west and central areas. • **Drainage:** The alignment crosses multiple minor rivers and streams draining to Loch Garry south of the OHL. • **Topography:** Alignment is located on predominantly gentle hillsides with some flatter expanses. • **Evidence of Peat Instability** - None
SECTION 6	
Map 21: Fort Augustus	• **Peat:** The western areas of this section is predominantly Class 2 Peat with localised pockets of Class 1. Predominantly Class 5 Peat and mineral soils present towards Fort Augustus. • **Peat Hagging:** None identified in the immediate area. • **Exposed Bedrock:** Localised areas of exposed bedrock, predominantly near Loch Lundie in the west of this section. • **Forestry:** Localised areas of forestry and felled forestry near Doire Mor, Doire Daraich. Extensive forestry and felled areas near Auchteraw and Fort Augustus Substation. • **Drainage:** The alignment crosses multiple minor rivers and streams along this section. • **Topography**: Alignment is located on predominantly gentle hillsides with some flatter expanses.

LOCATION	DETAILS
	• **Evidence of Peat Instability** - None

Table 2-2 Geomorphology Summary: Alternative Alignment

LOCATION	DETAILS
Map 1	• **Peat**: Class 5 Peat is present in the western forested areas of this section, with an area of Class 2 Peat, Class 4 and mineral soils in the central section and Class 1 Peat mapped in the east. • **Peat Hagging**: None identified in the immediate area. • **Exposed bedrock**: No major areas of exposed outcrop identified. • **Forestry**: Alignment crosses areas of forestry and felled forestry in the western areas of this section. • **Drainage**: The alignment crosses the Broadford River and its tributaries a number of minor surface waters in this section - Allt a' Mhuillin, Allt na Cloiche Bideich, Allt an Loin Bhuidhe and Allt an Loin Bhain. Artificial drainage present in areas along the route. • **Topography**: The alignment is located along flatter expanses and gentle slopes in the west with steeper slopes in the central areas and flatter expanses in the east of the section. • **Evidence of Peat Instability** - None
Map 2	• **Peat**: Class 5 Peat is present in the central areas of this section, with minor areas of Class 2 and Class 3 Peat mapped in the east. • **Peat Hagging**: None identified in the immediate area. • **Exposed bedrock**: No major areas of exposed outcrop identified. • **Forestry**: Alignment crosses areas of forestry and felled forestry in the central areas of this section. • **Drainage**: The alignment crosses a couple of minor tributaries in this area and is situated alongside the River Allt Mor. • **Topography**: The alignment is located along flatter expanses and gentle slopes alongside the River Allt Mor. • **Evidence of Peat Instability** - None
Map 3	• **Peat**: The majority of this section is mapped as Class 3 Peat, with areas of Class 4 and 5 Peat in the east. • **Peat Hagging**: No major areas of peat hagging identified. • **Exposed bedrock**: Minor bedrock outcrops identified throughout this area. • **Forestry**: Alignment is situated alongside an area of forestry in the centre of this section and crosses an extensive area of forestry present in the east. • **Drainage**: Alignment crosses multiple minor rivers and streams, predominantly draining to River Allt Mor in the west and Kyle Rhea in the east of this area. • **Topography**: This section of the alignment is present on relatively gentle hillsides with localised stepper sections. • **Evidence of Peat Instability** - None

3.0 Peat Instability

This Part of the report 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[12]. 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.

3.1 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[13] 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.

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[14], 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.

12 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.

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

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

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[15] (1926). The humification value ranges from H1 (no decomposition) to H10 (highly decomposed). The extended system set out by Hobbs[16] 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.

3.2 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 off-set 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.

3.2.1 Mechanisms that Contribute to Peat Instability

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

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

16 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.

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 below:

- 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 *el al* [17] 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.

3.3 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.

17 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.

3.3.1 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. A brief description is given below:

- 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 [18];
- 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[17]; and
- 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.

3.3.2 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 in excess of 1.5m with no upper limit;
- shallow gradients, generally within the range of 2 to 10^{o}, peat thicker than 1.5m is generally not observed on slopes steeper than 10^{o}, 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)[19];
- 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.

3.3.3 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 2m;
- slope gradients between 5^{o} and 15^{o};
- natural or artificial drainage cut into the surrounding peat landscape;
- greater humification of the lower catotelm within the waterlogged ground; and

18 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.
19 Crisp, D.T., Dawes, M. & Welch, D. (1964), 'A Pennine Peat Slide', The Geographical Journal, Vol 130, No4, pp519-524.

- 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.

3.3.4 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 acrotelmic and catotelmic layer.

3.3.5 Natural Instability

The stability of a peat mass is maintained by a complex interrelationship of many factors, some of which may not be immediately obvious. 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.

4.0 Fieldwork

Fieldwork surveys were conducted across a number of phases by SLR. The surveys carried out followed best practice guidance for developments on peatland[20,21]. The various phases of fieldwork surveys undertaken by SLR are summarised below:

- November / December 2021 – Section 3 peat probing to collect peat depth and condition data;
- January/February 2022 – peat probing to collect peat depth and condition data, primarily along Sections 0, 1, 2, 3 and 6. Limited probing was been undertaken along Sections 4 and 5;
- January 2023 –peat probing to collect peat depth and condition data, primarily along Section 4 and 5; and
- April 2023 – Section 1 and 2 peat probing and peat auguring.

All the identified peat areas were inspected, and confirmation probing was undertaken. The inspection was not limited to the immediate boundaries of the mapped peat areas but included observations of areas both up-slope and down-slope of the alignment and along access routes where appropriate, although many of these tracks were existing tracks used locally for estates and forestry.

The fieldwork included the collection of 10,343 peat probes. The aim of the survey was to characterise the peat depth within the Limits of Deviation (LoD). The location of the probes was chosen following site reconnaissance in combination with the location of the inferred peat rich soils/peat from the desk study, along the alignment of the Proposed Development. A complete list of data from the peat probing exercise is included in **Annex A: Peat Probes.**

The probing typically comprised one peat probe at the centre of a proposed pole or tower location, and points located within the LoD to allow interpolation of the peat data.

Probing was undertaken along the OHL / cable alignment and varied subject to ground conditions, where the ground was predominantly shallow rock the probes were undertaken every 50m and where the ground was a softer substrate, two lines were undertaken at 50m intervals within the identified LoD. This data is also supported by SI information which includes borehole records at proposed tower locations. Targeted peat probing, which typically comprised higher density probing (<10m density) was typically undertaken at tower or wood pole locations in areas where peat >0.5m depth was recorded.

Data collection characterised peat depth and provided preliminary information on balance of catotelmic and acrotelmic peat. The data has been used to support the production of peat depth mapping and to inform both the production of this PLHRA, and a Stage 1 Peat Management Plan (PMP), included as **Appendix V2-7.3** of the EIA Report.

4.1 Peat Survey Methodology

The thickness of the peat was assessed using a graduated peat probe, approximately 6mm diameter and capable of probing a depth of more than 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 ±4 metres, which was considered sufficiently accurate for this survey. All data was uploaded into a GIS database for incorporation into various drawings and analysis assessments. Peat depth maps (shown on **Figure V2-7.2.2** and **Figure V6-**

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

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

7.2.2) were produced to show interpolated peat depths where peat probing was undertaken. The method of interpolation between peat probe points used was 'Inverse Distance Weighting' (IDW).

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.

An assessment of the substrate was made and recorded at each probe hole.

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). Some areas, especially on slopes, were a little drier, resulting in the peat being stiffer and more difficult to fully penetrate. In all instances refusal was met on obstructions allowing identification of subsurface geology.

A Russian Peat Auger was used to recover peat cores to allow visual assessment and characterise the peat.

4.2 Peat Survey Results

The peat was found to vary in terms of thickness, surface slopes and apparent natural characteristics.

Peat thickness varies from zero to 7.8 m. Accumulations of peat less than 0.5 m thick are too thin to be classified as true peat deposits and are often classified as organic soils or peaty soils. The peat thickness was examined by review of the probe information from the investigation and is discussed below.

A total of 10,343 peat probes were undertaken across all survey phases, with the results summarised in Table 4-1. The peat thickness at each location was recorded and the data used to produce peat depth plans detailed on **Figure V2-7.2.2** and **Figure V6-7.2.2**.

Table 4-1: Peat Probe Results

Peat Thickness (m)	No. of Probes	Percentage (of total probes advanced)
0 (no peat)	493	4.8
0.01 – 0.49 (peaty soil)	5817	56.2
0.50 – 0.99	2166	20.9
1.00 – 1.49	702	6.8
1.50 – 1.99	475	4.6
2.00 – 2.49	240	2.3
2.50 – 2.99	175	1.7
3.00 – 3.49	112	1.1
3.50 – 3.99	69	0.7

Peat Thickness (m)	No. of Probes	Percentage (of total probes advanced)
> 4.0	94	0.9

4.3 Peat Condition

The geomorphology of the peat varies between some flat expanses of thick peat with high moisture content and smaller areas of thinner drier deposits blanketing the flanks of the hills.

The shear strength of the peat was assessed from inspection of natural exposures and found to be in the range very soft to firm (<10-45 kPa).

Based on interpretation from probing and peat auger samples, the extensive areas of deeper peat within the flatter areas becomes predominantly amorphous with depth. There are some localised deposits of shallow peat that generally comprise fibrous to pseudo-fibrous layers.

Based on field descriptions at augering points, most of the deeper peat present in the flatter areas of the site would be classified between H9 to H10 in the von Post classification, with a high level of decomposition recorded. Some of the locations have shallower peat classified as H5 to H8 of moderate to very strong decomposition. Peat Core logs and photographs with locations are presented within Annex B.

4.4 Substrate

From the evidence of the probing and sampling, the substrate falls into one of two principal categories:

- Granular (sand and/or gravel/weathered rock), of glacial origin and occasionally interbedded with silty sands;
- Rock, no rock samples were recovered from the probe locations although where exposed, the rock is seen to be metamorphic rocks; and

Limited cohesive horizons were interpreted by the probing, however evidence from the site walkovers did not visually identify cohesive soils. It is likely that any cohesive material is weathered silty material at the top of the weathered glacial material.

5.0 Slope Stability/Ground Conditions

The stability of slopes is dependent upon the shear strength of the soil to resist the disturbing forces due to the weight of the soil, the effects of the groundwater and other disturbing influencing forces.

The level of stability of a slope is normally assessed by reference to the factor of safety, which is expressed, numerically, as the degree of confidence that exists, for a given set of conditions, against a particular failure mechanism occurring. It is commonly expressed as the ratio of the load or action which would cause failure against the actual load or actions likely to be applied during service. This is readily determined for some types of analysis (e.g., limit equilibrium slope stability analyses).

5.1 Shear Strength

The strength of the peat in the upper acrotelm is significantly influenced by the root and fibres that are abundant in this layer. There are many influences on the stability of the peat and observing or measuring high shear strength should not be used to assume a high degree of stability.

5.2 Stability Risk Assessment

It is apparent that the stability of peat is complex and the numerous inter-relationships that affect the stability are not fully understood.

The problem with a quantitative assessment is that it requires a numerical input, and the 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 that a qualitative assessment of stability should be used to provide the final recommendations.

A stability risk assessment was undertaken to evaluate the risk of instability occurring associated with the locations of electrical distribution infrastructure and proposed access tracks.

6.0 Peat Landslide Hazard and Risk Assessment

A preliminary peat risk assessment has been undertaken. Following several phases of peat probing, site visits by an experienced SLR geotechnical engineer, and appraisal of ground investigation data, the potential for a peat slide occurring was initially assessed as medium, this was based on the fact that:

- although there are significant thicknesses of peat present on-site, the site infrastructure has generally avoided the thickest areas of peat; and
- steep gradients (>8°) where infrastructure overlying peat are proposed.

Where areas of medium and high risk are identified, further assessment is necessary.

The Proposed Development has some limited areas of forestry plantation which will require clearance. Forestry may potentially increase the likelihood of a peat slide occurring by altering natural drainage patterns and generating high pore-water pressures on potential rupture surfaces such as at the boundary between peat and the underlying substrate. This typically presents a greater risk during initial stages of the forest plantation following creation of drainage channels. There were no areas of significant peat instability identified within the typically mature and well-established forestry during the survey work.

To further quantify this initial assessment, analysis of the terrain utilising GIS has been undertaken to analyse slopes and gradients, as shown on **Figures V2-7.2.3** and **V6-7.2.3**. The site-specific slope data has been combined with site specific peat depth data and using Scottish Government Guidance[3] for the assessment of the risk of instability in peat, an assessment of peat slide risk has been completed.

Key factors which may influence the stability of the peat deposits have been identified leading to an assessment of the RISK of instability. The potential impact of any instability, the HAZARD, was then considered for identified potential receptors. Scores were attributed to the key factors that have the greatest influence on peat stability. Risk scores were determined, which, when combined with an assessment of vulnerability of potential targets, were developed into an assessment of the hazard.

To differentiate between risk and hazard, the following nomenclature has been adopted in Table 6-1.

Table 6-1: Risk versus Hazard

RISK	HAZARD
Negligible	Insignificant
Low	Significant
Medium	Substantial
High	Serious

This section outlines the approach taken and the scores allocated for various factors relevant to peat stability.

At this stage in the development, the objective is to determine the peat areas that would have an effect on the Proposed Development and to set out the mitigation that should be adopted and incorporated into the detailed design stage of the project.

The level of slope is normally assessed by reference to the factor of safety, which is expressed, numerically, as the degree of confidence that exists, for a given set of conditions, against a particular failure mechanism occurring. It is commonly expressed as the ratio of the load or action which would cause failure against the actual load or actions likely to be applied during service. This is readily determined for some types of analysis (e.g., limit equilibrium slope stability analyses).

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.

The key factors identified as being critical to stability and the development of a risk rating system are:

- A – Slope gradient;
- B – Peat thickness and ground conditions;
- C – Substrate type; and
- D – Historic instability.

The risk scores are multiplied together to generate a risk rating which is a measure of the likelihood of peat instability. Each are discussed below.

6.1 Slope Gradients

The slope gradients were assessed by reference to the mapping and particularly the DTM which was used to generate a gradient map shown on **Figure V2-7.2.3** and **Figure V6-7.2.3**, from which the gradient at each probe location could be determined and input into the risk rating spread sheet (**Appendix A**). The gradient quoted at each location was based on the average gradient over a 5m grid.

Table 6-2: Coefficients for Slope Gradients

Slope Angle (^{o})	Slope Angle Coefficients
Slope <2^0	1
>2^0 Slope <4^0	2
>4^0 Slope <8^0	4
>8^0 Slope <12^0	6
>12^o Slope	8

Coefficients for slope gradient have been assigned to ensure the potential for both peat slides (gradients of 4-15^0) and bog slides (gradients of 2-10^0) 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 0^0 to >12^0 (the practical maximum gradient on which peat is commonly observed) has been applied.

It is evident from the slope plan (**Figure V2-7.2.3** and **V6-7.2.3**) that most of the Proposed Development is located on areas with moderate to very steep gradients (4->12^o).

6.2 Peat Thickness and Ground Conditions

The ground conditions were assessed by using peat depths recorded during peat probing. Thin peat was classed as being 0.5m 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. Table 6-3 gives the coefficients applied to the various ground conditions.

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 is applied.

Table 6-3: Coefficients for Peat Thickness and Ground Conditions

Ground Conditions	Ground Condition Coefficients
Peaty or organic soil (<0.5 m)	1
Thin Peat (0.5 – 1.5 m)	2
Thick Peat (>1.5 m)	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 the steeper gradients.**

6.3 Substrate Type

As noted above, most failures in thin peat layers occur at the interface with the underlying substrate; the nature of the substrate has a very large influence on the probable level of stability.

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 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 6-4: Coefficients for Substrate

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

If the overall thickness of the peat had not been proven, the risk associated with the significant thickness and the unknown substrate would have been given a high rating to accommodate the unknown factors. The depth of peat, has, however, been proven at all locations as part of this study.

6.4 Risk Rating

The probability of a peat landslide rating coefficient (score) was derived by multiplying the coefficients for the four key factors (with historic instability as 1) identified in the above sections 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 stability risk assessment, the following Probability of a Peat Landslide classes were applied as shown in Table 6-5.

Table 6-5: Probability of Peat Landslide

Risk Rating Coefficient	Potential Stability Risk (Pre-Mitigation)	Action
<5	Negligible	No mitigation action required.
5 - <15	Low	As for negligible condition plus development of a site-specific construction and management plan for peat areas.
15 - <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.

The rating system outlined above differs slightly from that proposed in the Scottish Government Guidance[3] as the system adopted here incorporates three inputs compared to two in the guidance, with the potential impact of substrate added in this section.

6.5 Hazard Score Development

A further assessment of the medium and high 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. These assessments do 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. There are two locations noted in Table 6-11 that are located close to communities. The proposed mitigation measures in Section 7.0 would limit the potential for any slope failures into watercourses 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; but rather to assess the effect a particular infrastructure feature (track, tower/pole 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.

6.6 Receptor Ranking

Now the infrastructure features with a ‘medium’ or higher risk rating for instability have been identified it is necessary to identify potential impact receptors. These are 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. 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.

Following identification of receptors at risk, these are ranked according to their size and sensitivity. Table 6-6 presents the coefficients placed on particular receptor types. Watercourses and communities are deemed significant receptors potentially at risk from peat slides.

Table 6-6: Coefficients for Impact Receptor Ranking

Nature of Feature	Feature Coefficient
Non-critical infrastructure (minor/private roads, tracks)	1
Watercourses and critical infrastructure (pipelines, motorways, dwellings and business properties etc.)	3
Sub-Community (settlement 1-10 residents)	6
Community (settlement of >10 residents)	8

6.7 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 6-7 and Table 6-8 present the coefficients derived for distance and elevation of impact receptors.

Table 6-7: Coefficient for Impact Feature Distance

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

Table 6-8: Coefficient for Impact Feature Elevation

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

6.8 Impact Rating

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.

Based on distance to impact receptors, in this instance we have identified watercourses and communities as the most sensitive receptors. Watercourses are typically the closest receptor and they are at risk of not only direct impact from a peat slide but potentially the watercourse creates a pathway to impact other receptors indirectly, either ecological or potential water users downstream. Based on Table 6-6 the watercourses would have an impact receptor coefficient (score) of 3 and communities (score) of 8 and then considering the distance to the receptor and the relative elevation differences on-site of receptors, a potential impact can be derived.

6.9 Hazard Ranking

The Scottish Government Guidance[3] recommends that the hazard ranking is assessed using the following formula:

1. **Hazard Ranking = Hazard x Exposure**

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

2. **Hazard Ranking = Risk Rating x Impact Rating**

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 as shown in Table 6-9.

Table 6-9: Rating Normalisation

Risk Rating		Impact Rating	
Current Scale	Normalised Scale	Current Scale	Normalised Scale
Negligible <5	1	Very Low <10	1
Low 5 - <15	2	Low 11 - 20	2
Medium 15 - 30	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 we have used 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[3]. The ultimate Hazard Ranking scale does equate to the Scottish Government[3] scale, with hazard rankings divided over four zones, as illustrated in Table 6-10.

Table 6-10: Hazard Ranking

Hazard Ranking	Hazard Ranking Zone	Action
1-4	Insignificant	No mitigation action required although slide management and monitoring shall be employed.

Hazard Ranking	Hazard Ranking Zone	Action
		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.

6.10 Results

The main activities which have the potential to impact on the peat resource are the construction of access tracks, underground cabling and cable sealing end compounds, and the construction of pole / tower foundations.

The stability risk assessment, see Annex A, has demonstrated that the majority of the Proposed Development lies within an area of negligible to low risk (80% of probe locations) with regards to peat stability. 20% of probe locations have identified a medium or high risk of peat instability. Following a 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 relevant receptors. Therefore 31 medium risk and 50 high risk sites have been identified and are discussed in the following section.

The stability risk assessment results presented in Table 6-11 shows the calculated hazard ranking associated with every location where there is a stability risk of medium or above, at or close to the proposed 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 6-11, together with the associated, revised hazard ranking. A more detailed discussion of the possible mitigation measures is presented in Section 7.0.

6.11 Hazard Rated Locations

As noted in **Figures V2-7.2.4** and **V6-7.2.4**, 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 practise 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 7.0.

The areas of the infrastructure that were rated as medium or high risk, or above, 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 infrastructure. There is a significant number of medium or high risk sites located along tracks, this is predominantly a function of localised pockets of thick peat on steep slopes overlying bedrock. The model in fact increases the risk factor where bedrock is the underlying substrate rather than a glacial material which is predominantly granular. The risk factor therefore is very conservative and will be mitigated through good construction techniques including appropriate drainage and excavation to minimise risk.

The procedure adopted was to review **Figures V2-7.2.4** and **V6-7.2.4** 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.

The assessment carried out in Table 6-11 and Table 6-12 was completed as described in the sections above. For example, Location 1 (Table 6-11) has a risk rating of 3 (derived from Table 6-5) with an impact rating of 2 (derived from the process described in Section 6.11 and normalised in Table 6-9). These ratings are multiplied (3x2) to give a hazard ranking of 6 (significant), as detailed in Table 6-11.

Although the majority of potential hazards identified in Table 6-11 and Table 6-12 can be mitigated to 'insignificant' it is believed that hazards should be subject to further post consent investigation and on-going monitoring during construction. Further details of mitigation during construction are described in Section 7.0.

Table 6-11: Stability and Hazard Risk Ranking Assessment

Section	Location No.	Grid Coordinates		Risk Rating	Impact Rating	Hazard Ranking	Mitigation	Revised Hazard Ranking
0	1	126505	858894	Medium	Low	Significant	Model impacted by localised thick peat (max 1.8 m) and steep slope (<10°) at pole location AD52. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the southeast. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Insignificant
0	2	126950	857079	Medium	Very High	Substantial	Model impacted by thin peat (max 1 m) and steep slope (<9°) at pole location AD77. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the west.	Insignificant
0	3	127417	855742	Medium	Very High	Substantial	Model impacted by thin peat (max 0.6 m) and very steep slope (<17°) at pole location AD96. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the west.	Insignificant
0	4	127406	854742	High	Low	Significant	Model impacted by thin peat (max 1.4 m) and very steep slope (<15°) at pole locations AD105, AD109 and AD112. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the west.	Insignificant
0	5	127767	853095	High	High	Substantial	Model impacted by thick peat (max 1.6 m) and very steep slope (<14°) at pole locations AD120 to AD139. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the west. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Insignificant
0	6	127970	851950	Medium	Low	Significant	Model impacted by thin peat (max 0.7 m) and steep slope (<12°) at pole location AD144. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the west.	Insignificant
0	7	128510	851219	Medium	Low	Significant	Model impacted by thin peat (max 1.2 m) and moderate slope (<6°) at pole locations AD155 to AD157. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the southwest.	Insignificant
0	8	127918	850730	High	Low	Significant	Model impacted by thick peat (max 2.5 m) and steep slope (<12°) at pole locations AD164 to AD169. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the west. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Insignificant

Section	Location No.	Grid Coordinates		Risk Rating	Impact Rating	Hazard Ranking	Mitigation	Revised Hazard Ranking
0	9	127830	850026	Medium	Low	Significant	Model impacted by thin peat (max 1 m) and very steep slope (<13°) at probe locations AD173 to AD180. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the west.	Insignificant
0	10	127696	848377	Medium	Very Low	Insignificant	Model impacted by thin peat (max 1.4m) and moderate slope (<8°) at pole locations AD197 to AD199. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the west.	Insignificant
0	11	127729	847821	Medium	Low	Significant	Model impacted by thin peat (max 1 m) and moderate slope (<7°) at pole location AD205. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the west.	Insignificant
0	12	127708	847272	Medium	Low	Significant	Model impacted by thick peat (max 2.2 m) and moderate slope (<6°) at pole location AD212. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the west. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Insignificant
0	13	127962	846844	Medium	Low	Significant	Model impacted by thin peat (max 1.1 m) and moderate slope (<5°) at pole location DE6. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the southwest.	Insignificant
0	14	129219	845682	Medium	Low	Significant	Model impacted by thick peat (max 2.7 m) and moderate slope (<8°) at pole locations DE24 to DE30. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the southwest. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Insignificant
0	15	129751	845499	Medium	Very Low	Insignificant	Model impacted by thick peat (max 1.7 m) and moderate slope (<8°) at pole locations DE34 and DE35. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the southwest. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Insignificant
0	16	134416	843971	Medium	Low	Significant	Model impacted by thick peat (max 3.2 m) and steep slope (<9°) at pole location DE106. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the southeast. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Insignificant
1	17	136333	843581	Medium	Low	Significant	Model impacted by thick peat (max 1.9 m) and moderate slope (<5°) at tower location BE102. Excavation of localised peat	Insignificant

Section	Location No.	Grid Coordinates		Risk Rating	Impact Rating	Hazard Ranking	Mitigation	Revised Hazard Ranking
							deposits prior to construction would reduce risk and mitigate peat landslide to the southeast. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	
1	18	141459	843192	Medium	Very Low	Insignificant	Model impacted by thick peat (max 1.7 m) and moderate slope (<7°) along new permanent access track to tower BE83. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the southeast. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Insignificant
1	19	144039	838035	Medium	Low	Significant	Model impacted by thick peat (max 3.3 m) and very steep slope (<19°) at tower locations BE61 and B62 and permanent access track. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the northeast. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Significant
1	20	147986	832344	Medium	Low	Significant	Model impacted by thick peat (max 2.6 m) and steep slope (<9°) at tower location BE33. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the southwest. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Insignificant
1	21	148042	832029	Medium	Very Low	Insignificant	Model impacted by thin peat (max 1 m) and moderate slope (<7°) at tower location BE32 and permanent access track. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the southwest.	Insignificant
2	22	157395	826965	Medium	Low	Significant	Model impacted by thin peat (max 0.8 m) and steep slope (<11°) at tower location BE27 and permanent access track. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the southwest.	Insignificant
2	23	161461	824983	Medium	Low	Significant	Model impacted by thick peat (max 1.5 m) and moderate slope (<6°) at tower locations along permanent access track between BE6 and BE7. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the northwest. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Insignificant
3	24	162996	823845	Medium	Very Low	Significant	Model impacted by thick peat (max 3.9 m) and moderate slope (<6°) at tower locations along permanent access track between BF3 and BF4. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the	Significant

Section	Location No.	Grid Coordinates		Risk Rating	Impact Rating	Hazard Ranking	Mitigation	Revised Hazard Ranking
							northeast. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	
3	25	170822	822993	High	Low	Significant	Model impacted by thick peat (max 3.5 m) and very steep slope (<16°) along permanent access and tower BF35. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the east. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Significant
3	26	175220	824346	Medium	Very Low	Insignificant	Model impacted by thick peat (max 1.8 m) and slight slope (<4°) along permanent access track leading to tower BF54. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the south. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Insignificant
3	27	175514	824552	Medium	Low	Significant	Model impacted by thin peat (max 0.7 m) and very steep slope (<15°) along permanent access track leading to tower BF55. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the north. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Insignificant
3	28	175847	824369	Medium	Low	Significant	Model impacted by thin peat (max 1.3 m) and very steep slope (<19°) along permanent access track leading to tower BF57. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the northeast. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Insignificant
3	29	176093	824594	High	Low	Significant	Model impacted by thin peat (max 0.7 m) and very steep slope (<23°) along permanent access track leading to tower BF57. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the northeast. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Insignificant
3	30	176704	824555	Medium	High	Significant	Model impacted by peaty soil (max 0.2 m) and steep slope (<11°) along permanent access track leading to tower BF60. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the north. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Insignificant
3	31	177186	824631	High	Low	Significant	Model impacted by thick peat (max 1.6 m) and very steep slope (<23°) at tower location BE61 and permanent access track.	Insignificant

Section	Location No.	Grid Coordinates		Risk Rating	Impact Rating	Hazard Ranking	Mitigation	Revised Hazard Ranking
							Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the northwest. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	
3	32	177704	824854	High	High	Substantial	Model impacted by thin peat (max 0.6 m) and very steep slope (<19°) between tower locations BE63 and BE64. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the northeast. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Insignificant
3	33	178347	825018	Medium	Low	Significant	Model impacted by thin peat (max 0.9 m) and very steep slope (<16°) on permanent access track to BE65. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the north. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Insignificant
3	34	179305	824732	Medium	Low	Significant	Model impacted by peaty soil (max 0.2 m) and very steep slope (<23°) on permanent access track to BE73. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the northwest.	Insignificant
3	35	179472	824576	Medium	Low	Significant	Model impacted by peaty soil (max 0.3 m) and very steep slope (<15°) on permanent access track to BE75. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the west.	Insignificant
3	36	179371	824115	Medium	Low	Significant	Model impacted by peaty soil (max 0.2 m) and very steep slope (<15°) on permanent access track to BE77. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the west.	Insignificant
3	37	179472	823946	Medium	Low	Significant	Model impacted by peaty soil (max 0.3 m) and very steep slope (<15°) on permanent access track to BE77. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the west.	Insignificant
4	38	180269	822151	High	High	Substantial	Model impacted by thick peat (max 2.5 m) and very steep slope (<21°) at tower location BF83. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the east. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Insignificant
4	39	180795	821898	Medium	Low	Significant	Model impacted by peaty soil (max 0.3 m) and very steep slope (<13°) at access track and tower BF86. Excavation of localised	Insignificant

Section	Location No.	Grid Coordinates		Risk Rating	Impact Rating	Hazard Ranking	Mitigation	Revised Hazard Ranking
							peat deposits prior to construction would reduce risk and mitigate peat landslide to the west.	
4	40	181231	822163	High	Very Low	Insignificant	Model impacted by thin peat (max 1 m) and steep slope (<12°) at access track leading to BF83. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the west. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Insignificant
4	41	182160	821176	High	Low	Significant	Model impacted by thick peat (max 2.6 m) and steep slope (<9°) at access track and tower BF92. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the east. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Insignificant
4	42	183242	820165	Medium	High	Significant	Model impacted by thick peat (max 2.3 m) and moderate slope (<7°) along permanent access track leading to BF98. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the southwest. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Insignificant
4	43	183329	820014	Medium	Low	Significant	Model impacted by peaty soil (max 0.4 m) and very steep slope (<23°) along permanent access track leading to BF96. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the southwest.	Insignificant
4	44	184714	819636	High	Low	Significant	Model impacted by thick peat (max 1.8 m) and very steep slope (<22°) along permanent access track leading to BF106. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the northwest. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Significant
4	45	184464	819244	High	Low	Significant	Model impacted by thick peat (max 1.7 m) and very steep slope (<19°) along permanent access track leading to BF106. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the north. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Significant
4	46	184091	819205	High	Low	Significant	Model impacted by thick peat (max 1.8 m) and very steep slope (<12°) at access track and tower BF104. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the north. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Significant

Section	Location No.	Grid Coordinates		Risk Rating	Impact Rating	Hazard Ranking	Mitigation	Revised Hazard Ranking
4	47	184425	818591	High	Very Low	Significant	Model impacted by thick peat (max 4 m) and very steep slope (<18°) at access track and tower BF107. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the west. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Significant
4	48	184688	817601	High	Low	Significant	Model impacted by thin peat (max 1 m) and very steep slope (<15°) at access track and tower BF112. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the south. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Insignificant
4	49	185015	817271	Medium	Very Low	Insignificant	Model impacted by thick peat (max 3.2 m) and moderate slope (<10°) at access track and tower BF114. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the south. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Insignificant
4	50	185532	816762	High	Low	Significant	Model impacted by thin peat (max 0.9 m) and very steep slope (<16°) at tower BF117. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the south. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Insignificant
4	51	185928	816368	High	Low	Significant	Model impacted by thick peat (max 2.4 m) and very steep slope (<16°) at access track and towers BF119 to BF121. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the southwest. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Significant
4	52	188074	816449	Medium	Low	Significant	Model impacted by thin peat (max 0.7 m) and moderate slope (<9°) at access track leading to BF121. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the west. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Insignificant
4	53	188133	816763	High	Low	Significant	Model impacted by thin peat (max 0.7 m) and moderate slope (<10°) at access track leading to BF121. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the west. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Insignificant
4	54	188805	817249	High	Low	Significant	Model impacted by thick peat (max 3.2 m) and moderate slope (<10°) at access track leading to BF121. Excavation of localised peat deposits prior to construction would reduce risk and mitigate	Insignificant

Section	Location No.	Grid Coordinates		Risk Rating	Impact Rating	Hazard Ranking	Mitigation	Revised Hazard Ranking
							peat landslide to the north. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	
4	55	192727	808923	Medium	Low	Significant	Model impacted by thick peat (max 2.9 m) and moderate slope (<6°) at tower location BF165. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the northeast.	Insignificant
4	56	195938	806560	High	Low	Significant	Model impacted by thin peat (max 0.6 m) and very steep slope (<23°) at access track and tower location BF183. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the northeast.	Insignificant
4	57	195902	806186	High	Low	Significant	Model impacted by thick peat (max 3.3 m) and very steep slope (<16°) at tower location BF185. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the northeast.	Insignificant
4	58	196097	804775	Medium	Low	Significant	Model impacted by peaty soil (max 0.1 m) and very steep slope (<16°) at tower location BF192. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the east.	Insignificant
4	59	197247	804095	Medium	Low	Significant	Model impacted by thick peat (max 1.8 m) and moderate slope (<11°) at tower location BF199. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the southeast.	Insignificant
4	60	197539	803908	High	Low	Significant	Model impacted by thin peat (max 0.9 m) and very steep slope (<16°) at access track and tower locations BF200 to BF201. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the south.	Insignificant
4	61	198489	803798	Medium	Low	Significant	Model impacted by thick peat (max 1.6 m) and moderate slope (<12°) at access track and tower location BF204. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the south.	Insignificant
4	62	201689	804048	High	Low	Significant	Model impacted by thick peat (max 2.6 m) and very steep slope (<15°) at tower location BF218. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the east. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Significant
5	63	207466	802510	High	Low	Significant	Model impacted by thin peat (max 1.2 m) and very steep slope (<17°) at tower location BF246. Excavation of localised peat	Insignificant

Section	Location No.	Grid Coordinates		Risk Rating	Impact Rating	Hazard Ranking	Mitigation	Revised Hazard Ranking
							deposits prior to construction would reduce risk and mitigate peat landslide to the south.	
5	64	208885	802073	Medium	Very Low	Insignificant	Model impacted by thick peat (max 2.3 m) and moderate slope (<5°) at tower location BF252. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the south.	Insignificant
5	65	209347	802053	Medium	Very Low	Insignificant	Model impacted by thin peat (max 1.4 m) and moderate slope (<5°) at tower location BF254. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the south.	Insignificant
5	66	210707	801992	Medium	Low	Significant	Model impacted by thin peat (max 1 m) and moderate slope (<8°) at tower location BF259. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the west.	Insignificant
5	67	211235	801969	Medium	Very Low	Insignificant	Model impacted by thin peat (max 0.7 m) and moderate slope (<10°) at tower location BF261. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the south.	Insignificant
5	68	213398	801832	Medium	Low	Significant	Model impacted by thin peat (max 1.1 m) and moderate slope (<5°) at tower location BF270. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the southwest.	Insignificant
5	69	217297	801874	Medium	Low	Significant	Model impacted by thin peat (max 1.2 m) and moderate slope (<7°) at tower location BF286. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the west.	Insignificant
5	70	218912	802561	Medium	Very Low	Insignificant	Model impacted by thin peat (max 1.4 m) and moderate slope (<8°) at tower location BF294. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the west.	Insignificant
5	71	219625	802460	Medium	Low	Significant	Model impacted by thin peat (max 1.2 m) and very steep slope (<14°) at access track leading to location BF296. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the south.	Insignificant

Table 6-12: Stability Risk Ranking Assessment (Alternative Alignment)

Location No.	Grid Coordinates		Risk Rating	Impact Rating	Hazard Ranking	Mitigation	Revised Hazard Ranking
1	173317	821308	Medium	Low	Significant	Model impacted by thin peat (max 1.4 m) and steep slope (<11°) along permanent access track leading to BF48B. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the northeast. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Insignificant
2	173721	821149	Medium	Very Low	Insignificant	Model impacted by thick peat (max 2.2 m) and steep slope (<12°) along permanent access track leading to BF48B. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the northeast. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Insignificant
3	174326	820960	Medium	Very Low	Insignificant	Model impacted by thick peat (max 1.9 m) and very steep slope (<13°) along permanent access track leading to BF50B. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the north. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Insignificant
4	174802	820775	Medium	Very Low	Insignificant	Model impacted by thin peat (max 1.2 m) and steep slope (<9°) along permanent access track leading to BF52B. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the northeast. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Insignificant
5	175133	820630	Medium	Very Low	Insignificant	Model impacted by thin peat (max 1.4 m) and steep slope (<11°) along permanent access track leading to BF54B. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the north. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Insignificant
6	175470	820520	High	Low	Significant	Model impacted by thin peat (max 1.2 m) and very steep slope (<17°) along permanent access track leading to BF56B. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the east. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Insignificant
7	176231	820550	High	Very Low	Insignificant	Model impacted by thin peat (max 0.9 m) and very steep slope (<33°) along permanent access track leading to BF57B. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the south. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Insignificant
8	177044	820438	High	Low	Significant	Model impacted by thick peat (max 1.8 m) and steep slope (<12°) along permanent access track leading to BF61B. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the northeast. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Insignificant
9	178047	820732	Medium	Low	Significant	Model impacted by peaty soil (max 0.2 m) and very steep slope (<15°) along permanent access track leading to BF67B. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the south. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Insignificant

Location No.	Grid Coordinates		Risk Rating	Impact Rating	Hazard Ranking	Mitigation	Revised Hazard Ranking
10	178625	821334	Medium	Low	Significant	Model impacted by peaty soil (max 0.1 m) and very steep slope (<22°) along permanent access track leading to BF72B. Excavation of localised peat deposits prior to construction would reduce risk and mitigate peat landslide to the east. Risk could also be reduced by micro-siting and benching slope to mitigate risk of peat landslide.	Insignificant

7.0 Construction Activity and Peat Management

Construction activities are described in **Volume 1, Chapter 3: Project Description** of the EIA Report. This part of the Appendix outlines the general approach that will be taken by the Principal Contractor to minimise disturbance of peat during the construction period.

The Proposed Development will use the LoD specified to avoid areas of potential peat instability wherever possible. Specific measures proposed to minimise the potential effects from peat slide and on peat as a resource are described below.

- Micrositing will be used during the detailed design and construction phases to further avoid areas of peat or other high-risk areas. This would be undertaken under the direction of an environmental advisor and geotechnical engineer (as necessary).
- Tracks will be microsited to avoid the need for localised cut and fill, particularly on convex slopes.
- Underground cabling is on areas with minimal peat or very isolated areas of peat and hence negligible to low peat slide risk. A few localised areas indicate higher risk but these will not impact stability due to the limited extent. The cabling routes will be restored immediately after construction to minimise risk.
- Floating road may be installed in sensitive areas such as over deeper areas of peat (usually > 1 m). All new tracks would be constructed in accordance with best practice construction methods, and with reference to NatureScot's good practice guide on constructing tracks in Scottish uplands.
- Foundation design of proposed towers will consider the use of alternatives to pad and column foundations in areas of loose or deep superficial deposits (including peat) e.g., piled solutions.
- Geotechnical supervision will be provided throughout the construction phase.
- A Geotechnical Risk Register will be completed as part of the design phase.
- Concentrated loads, such as excavated material placed on the slope, create the single most adverse negative short-term effect on the stability of a slope. Accordingly, during the construction phase, all excavated materials will be removed to temporary storage mounds positioned at safe slope gradients and certified by a geotechnical engineer.
- Loading associated with the construction of floating tracks may lead to unstable ground conditions. Accordingly, all tracks will be, as far as possible, constructed under geotechnical supervision and monitored during and after construction.
- Excavation of the slope for foundations or for excavated tracks may remove toe support and increase potential for ground movements. The earthworks and any excavation will be designed and undertaken in such a way as to avoid any excavation of toe support material. The excavation of any temporary slopes will be fully designed.
- Disturbance to the natural drainage system may increase potential for peat instability. Therefore, the design of any new drainage will be undertaken to ensure no adverse loading is placed on areas of marginal peat stability.
- Since peat sliding invariably involves increased pore water pressures, it follows that robust drainage plans and engineering control of water during the development should result in a significant overall reduction in the risk of peat instability.

8.0 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:

- walk-over surveys 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 10,343 locations in areas of identified peaty soil/peat to determine its thickness, condition and characteristics.

The overall conclusion regarding peat stability is that there are areas of medium and high risk of peat instability across the Site although most of these have been avoided during the design process. For the medium and high risk areas, a hazard impact assessment was completed which concluded that, subject to micro-siting and the employment of appropriate mitigation measures the risk can be reduced to be considered as an insignificant. However, several locations have been highlighted as a residual significant risk. These areas will require to be assessed within a site-specific construction plan for peat as part of the detailed design stage of the project. Further investigation may be required to refine the assessment.

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

The assessment has purposefully kept the extent of physical intrusion into the sensitive peat areas to an absolute minimum. The results are considered appropriate to support a planning application.

More detailed ground investigations will be required to facilitate the geotechnical design of the various foundations and access tracks, particularly the vertical and horizontal alignment and the design of the river/stream crossings. These will be incorporated into the CEMP which will be submitted to the Planning Authority for approval prior to any site works commencing.

Figures

<u>Proposed Alignment</u>

Figure V2-7.2.1: Geomorphology

Figure V2-7.2.2: Peat Depth

Figure V2-7.2.3: Slope

Figure V2-7.2.4: Peat Slide Risk

<u>Alternative Alignment</u>

Figure V6-7.2.1: Geomorphology

Figure V6-7.2.2: Peat Depth

Figure V6-7.2.3: Slope

Figure V6-7.2.4: Peat Slide Risk

Skye Reinforcement Project

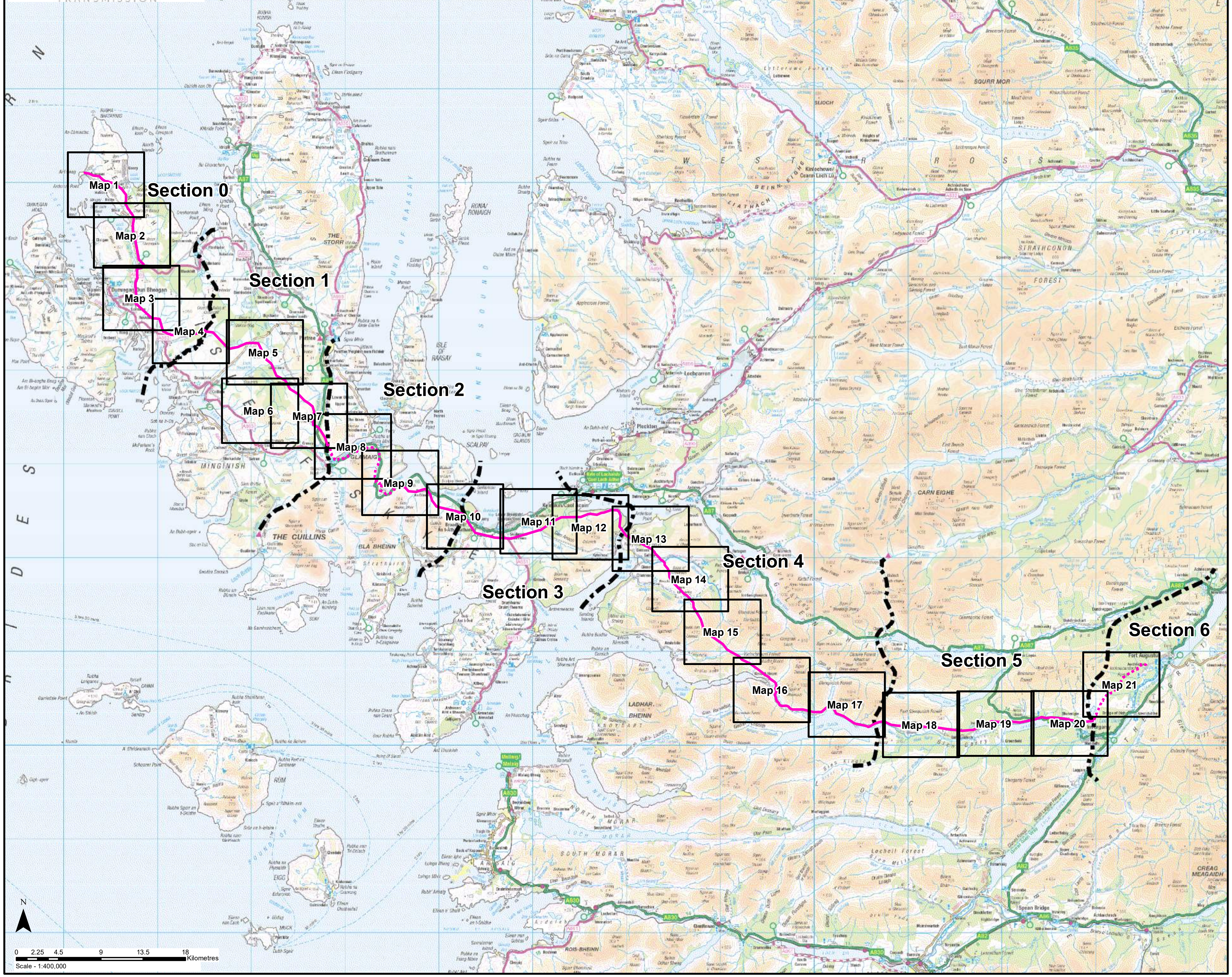
Appendix V2-7.2 – Peat Landslide Hazard and Risk Assessment

Scottish & Southern Electricity Networks (SSEN)

SLR Project No.: 428.04707.00020

19 July 2023

Scottish & Southern Electricity Networks
TRANSMISSION



Key

- Proposed OHL Alignment
- Proposed Underground Cable

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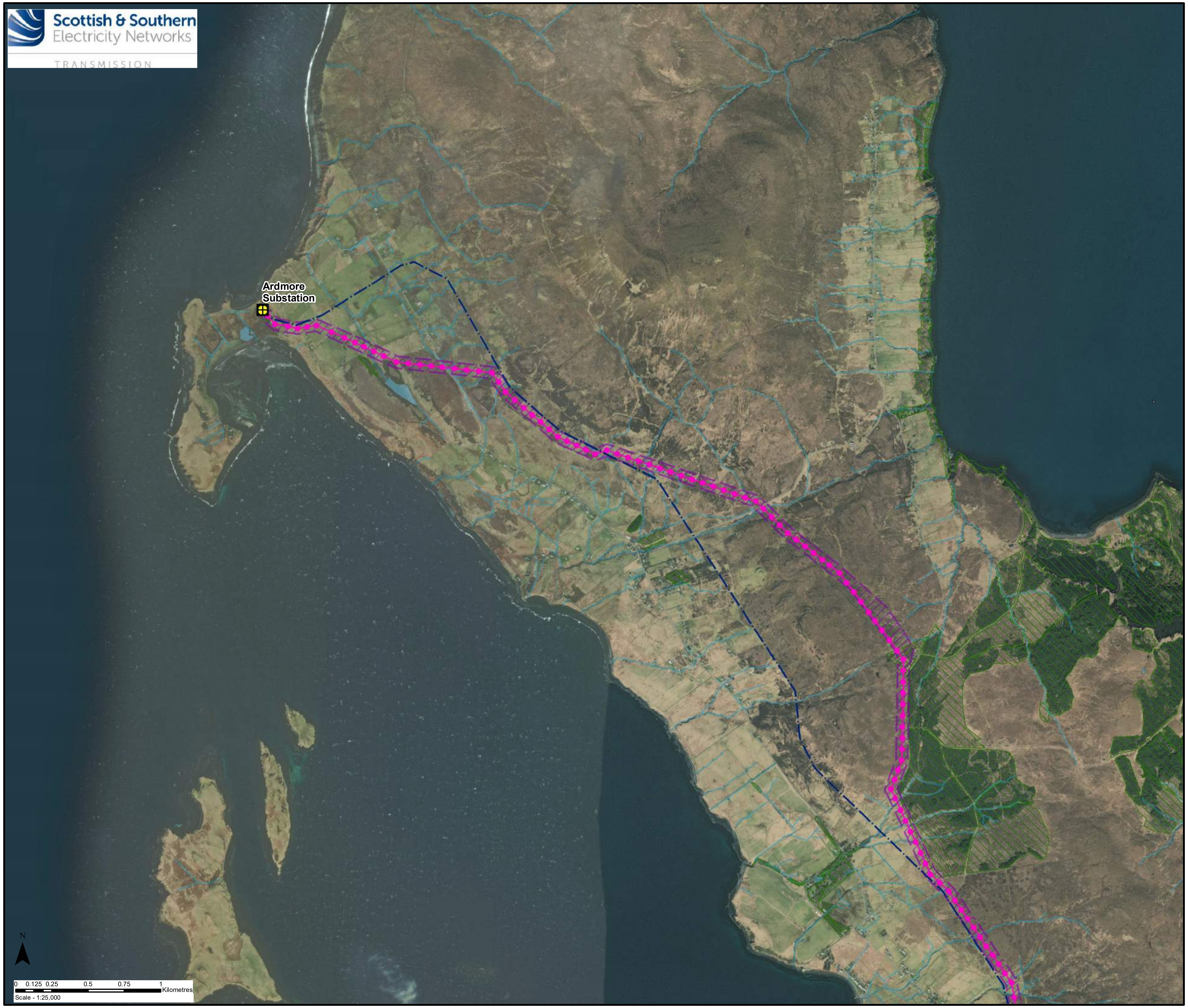
Aerial Imagery: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Project No:	LT91
Project:	Skye Reinforcement Project EIA Report
Title:	Figure V2-7.2.1 Geomorphology Plan Overview
Drawn by:	AA
Date:	14/06/2023
Drawing:	04707.00020.0158.0



Key

- Proposed OHL Alignment
- Proposed Wood Pole (H Pole)
- Limit of Deviation (OHL / Underground Cable)
- Existing 132 kV OHL to be Dismantled (Wood Pole)
- Existing Substation
- Watercourse
- Waterbody
- Woodland

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Aerial Imagery: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Project No: LT91

Project: Skye Reinforcement Project EIA Report

Title: Figure V2-7.2.1 Geomorphology Plan Map 1 - Section 0

Drawn by: AA Date: 14/06/2023

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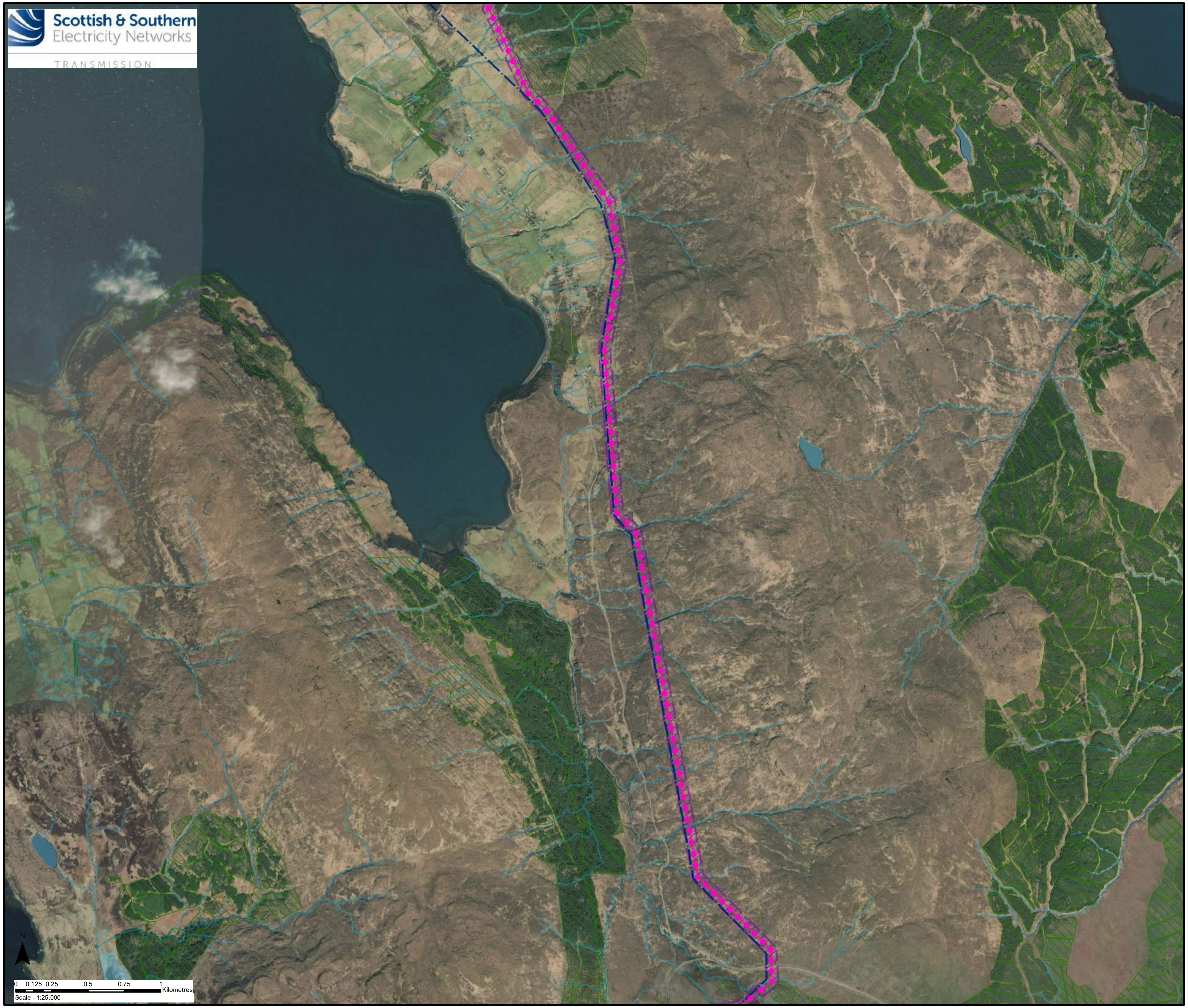

Key

- Proposed OHL Alignment
- Proposed Wood Pole (H Pole)
- Limit of Deviation (OHL / Underground Cable)
- Existing 132 kV OHL to be Dismantled (Wood Pole)
- Watercourse
- Waterbody
- Woodland

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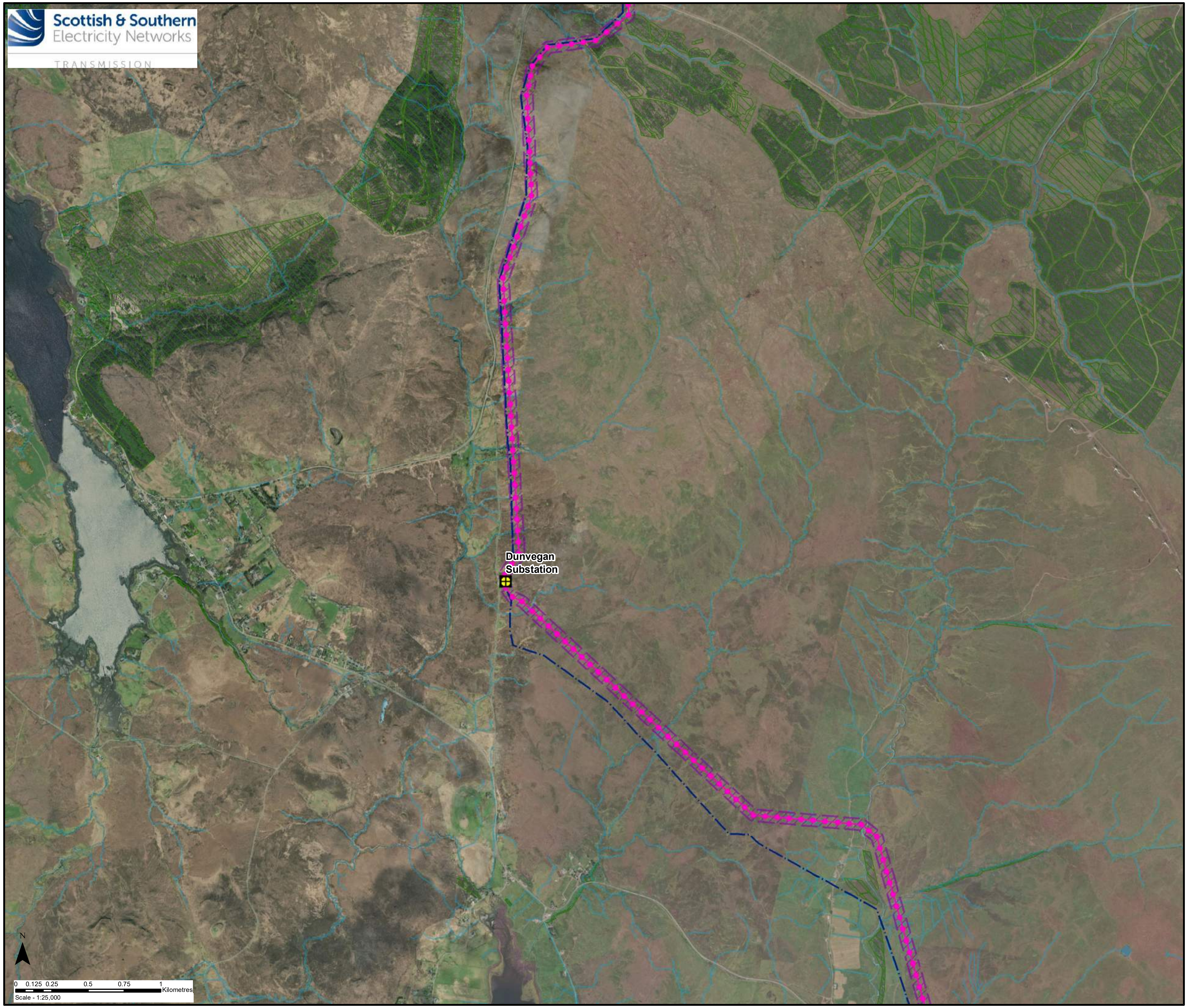
Aerial Imagery: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Project No:	LT91
Project:	Skye Reinforcement Project EIA Report
Title:	Figure V2-7.2.1 Geomorphology Plan Map 2 - Section 0
Drawn by:	AA — Date: 14/06/2023
Drawing:	04707.00020.0158.0



Key

- Proposed OHL Alignment
- Proposed Wood Pole (H Pole)
- Limit of Deviation (OHL / Underground Cable)
- Existing 132 kV OHL to be Dismantled (Wood Pole)
- Existing Substation
- Watercourse
- Waterbody
- Woodland

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Aerial Imagery: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

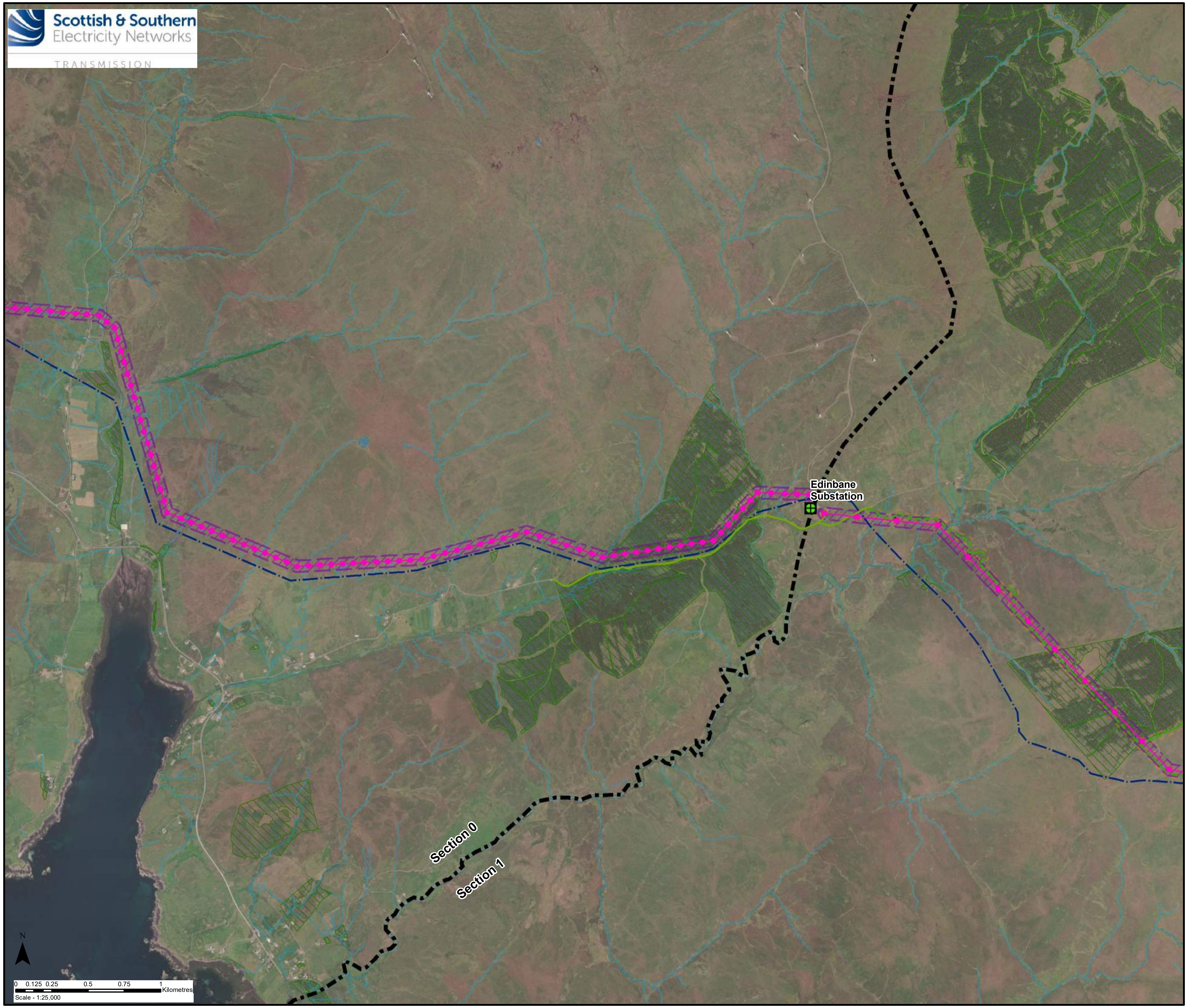
Project No: LT91

Project: Skye Reinforcement Project
EIA Report

Title: Figure V2-7.2.1
Geomorphology Plan
Map 3 - Section 0

Drawn by: AA Date: 14/06/2023

Drawing: 04707.00020.0158.0



Key

- Proposed OHL Alignment
- Proposed Wood Pole (H Pole)
- Proposed Steel Lattice Tower
- Limit of Deviation (OHL / Underground Cable)
- Existing 132 kV OHL to be Dismantled (Wood Pole)
- Existing Access Track
- New Temporary Access Track
- New Temporary Spur to Towers
- Limit of Deviation (Access Tracks)
- Existing Substation to be Extended (separate application)
- Watercourse
- Waterbody
- Woodland

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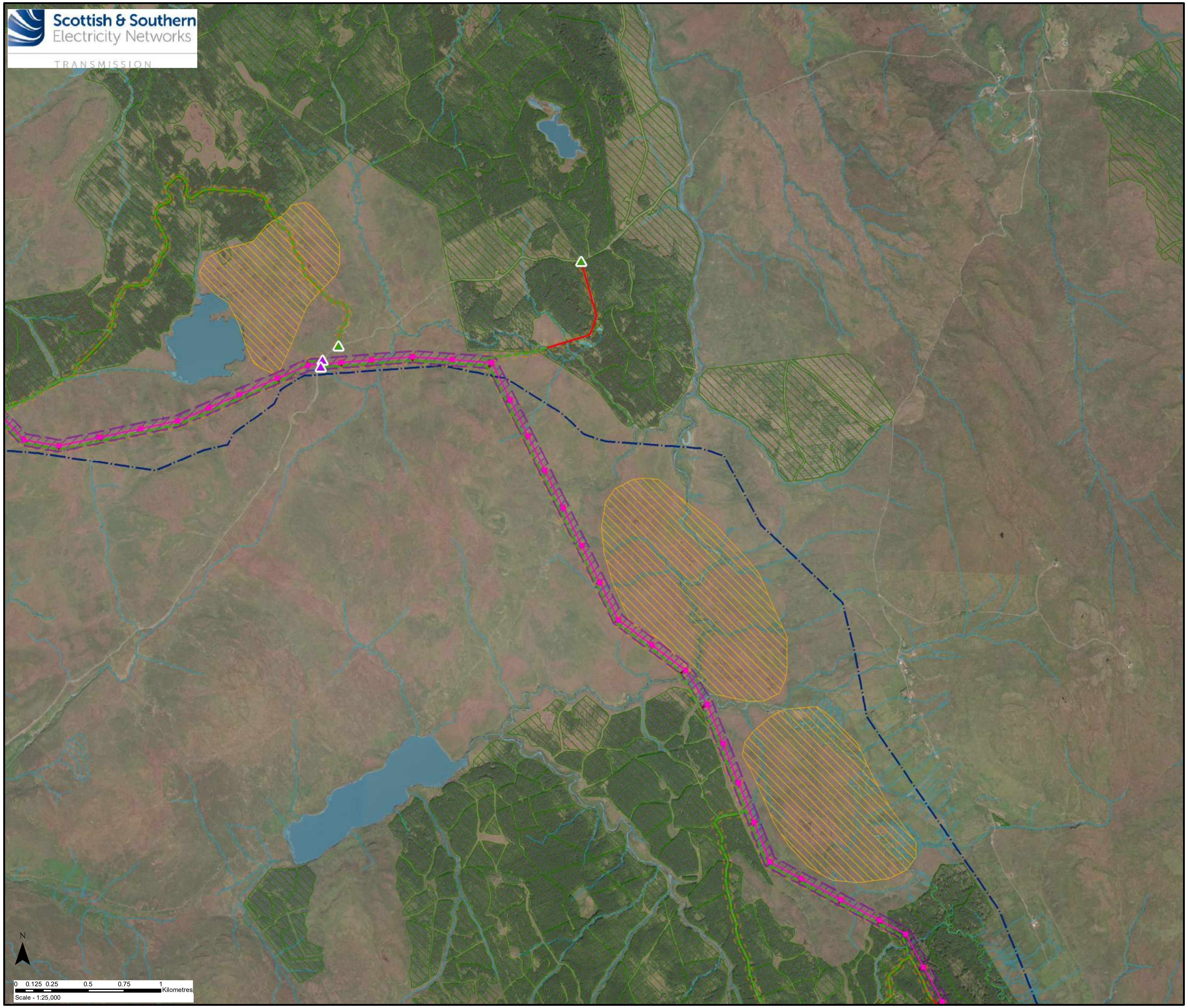
Project No: LT91

Project: Skye Reinforcement Project
EIA Report

Title: Figure V2-7.2.1
Geomorphology Plan
Map 4 - Sections 0 & 1

Drawn by: AA Date: 14/06/2023

Drawing: 04707.00020.0158.0



Key

- Proposed OHL Alignment
- Proposed Steel Lattice Tower
- Limit of Deviation (OHL / Underground Cable)
- Existing 132 kV OHL to be Dismantled (Wood Pole)
- Existing Access Track to be Upgraded
- New Permanent Access Track (construction type to be determined)
- New Temporary Access Track
- New Temporary Spur to Towers
- Existing Bellmouth
- Temporary Bellmouth
- Limit of Deviation (Access Tracks)
- Watercourse
- Waterbody
- Woodland
- Area of Peat Hagging

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Project No: LT91

Project: Skye Reinforcement Project EIA Report

Title: Figure V2-7.2.1 Geomorphology Plan Map 5 - Section 1

Drawn by: AA Date: 14/06/2023

Drawing: 04707.00020.0158.0

Scottish & Southern Electricity Networks
TRANSMISSION

Key

- Proposed OHL Alignment
- Proposed Steel Lattice Tower
- Limit of Deviation (OHL / Underground Cable)
- Existing 132 kV OHL to be Dismantled (Wood Pole)
- Existing Access Track to be Upgraded
- New Permanent Access Track (construction type to be determined)
- New Temporary Access Track
- New Temporary Spur to Towers
- Existing Bellmouth
- Limit of Deviation (Access Tracks)
- Watercourse
- Waterbody
- Woodland

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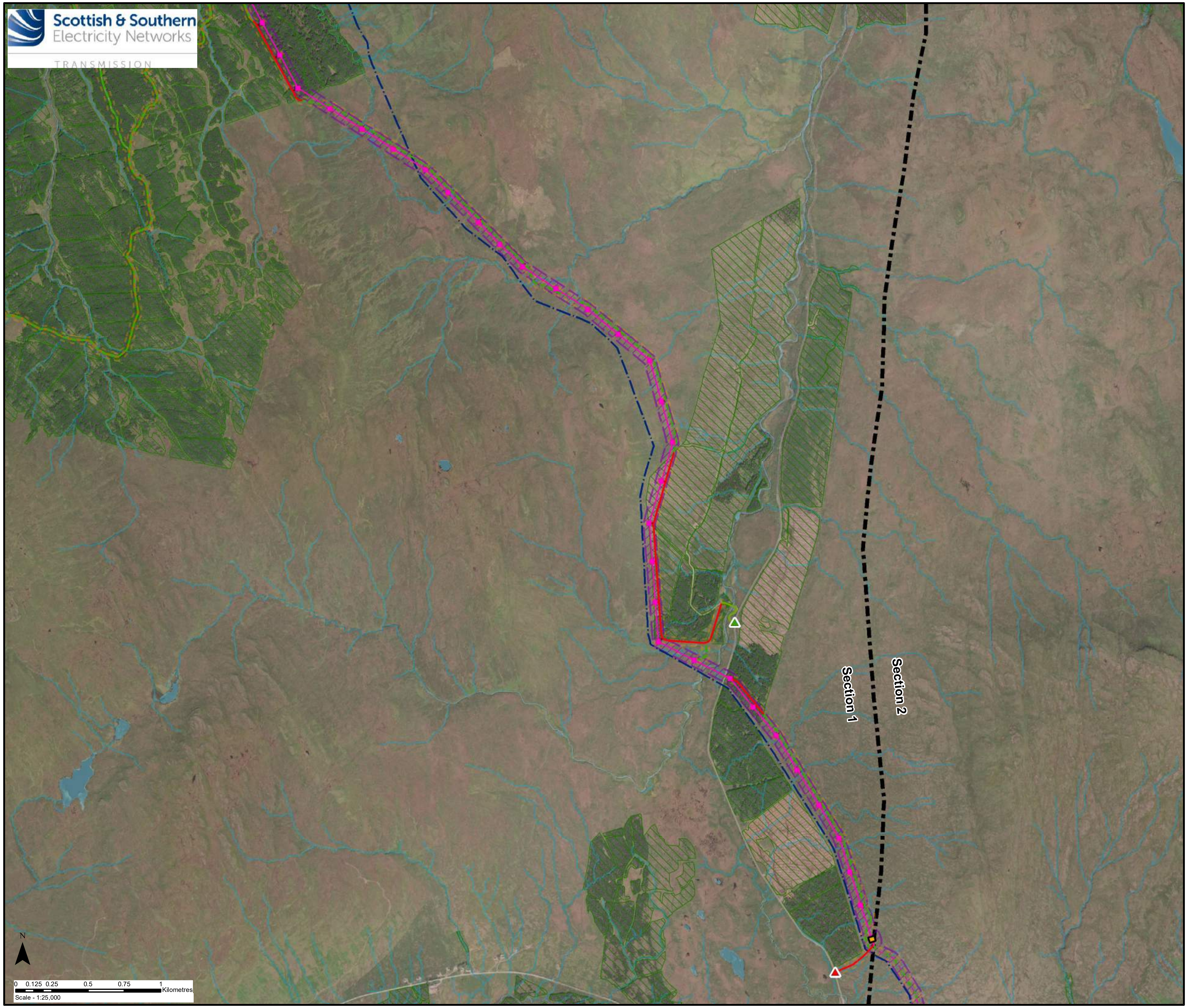
Project No:	LT91
Project:	Skye Reinforcement Project EIA Report
Title:	Figure V2-7.2.1 Geomorphology Plan Map 6 - Section 1
Drawn by:	AA
Date:	14/06/2023
Drawing:	04707.00020.0158.0



Key

- Proposed OHL Alignment
- Proposed Underground Cable
- Proposed Steel Lattice Tower
- Limit of Deviation (OHL / Underground Cable)
- Existing 132 kV OHL to be Dismantled (Wood Pole)
- Existing Access Track
- Existing Access Track to be Upgraded
- New Permanent Access Track (construction type to be determined)
- New Temporary Access Track
- New Temporary Spur to Towers
- Existing Bellmouth
- New Bellmouth
- Limit of Deviation (Access Tracks)
- Sealing End Compound
- Watercourse
- Waterbody
- Woodland

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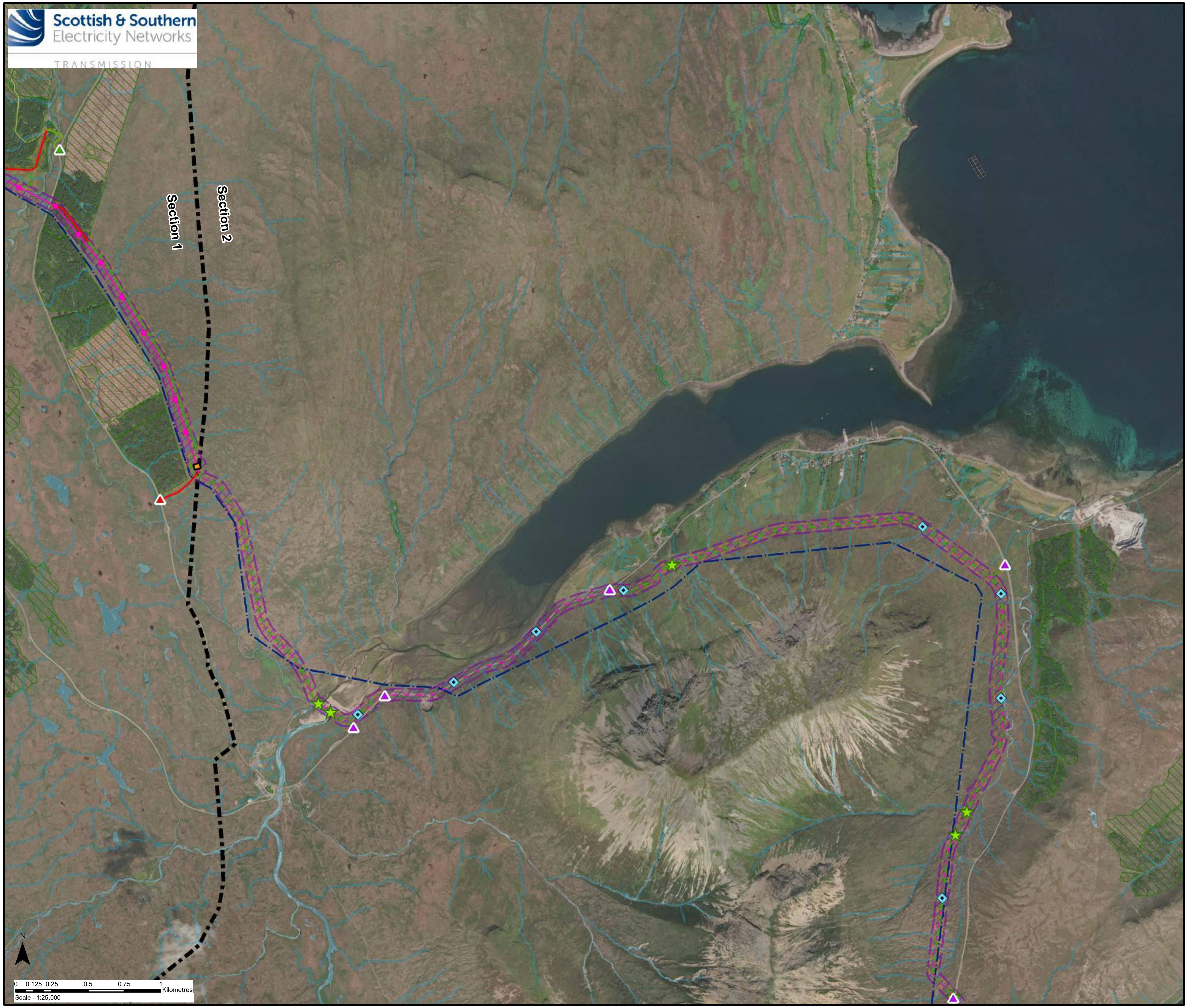
Project No:	LT91
Project:	Skye Reinforcement Project EIA Report
Title:	Figure V2-7.2.1 Geomorphology Plan Map 7 - Sections 1 & 2
Drawn by:	AA
Date:	14/06/2023
Drawing:	04707.00020.0158.0



Key

- Proposed OHL Alignment
- Proposed Underground Cable
- Proposed Steel Lattice Tower
- Indicative Cable Link Box
- Horizontal Directional Drill (HDD) Location (Indicative)
- Limit of Deviation (OHL / Underground Cable)
- Existing 132 kV OHL to be Dismantled (Wood Pole)
- Existing Access Track
- New Permanent Access Track (construction type to be determined)
- New Temporary Access Track
- New Temporary Spur to Towers
- Existing Bellmouth
- New Bellmouth
- Temporary Bellmouth
- Limit of Deviation (Access Tracks)
- Sealing End Compound
- Watercourse
- Waterbody
- Woodland

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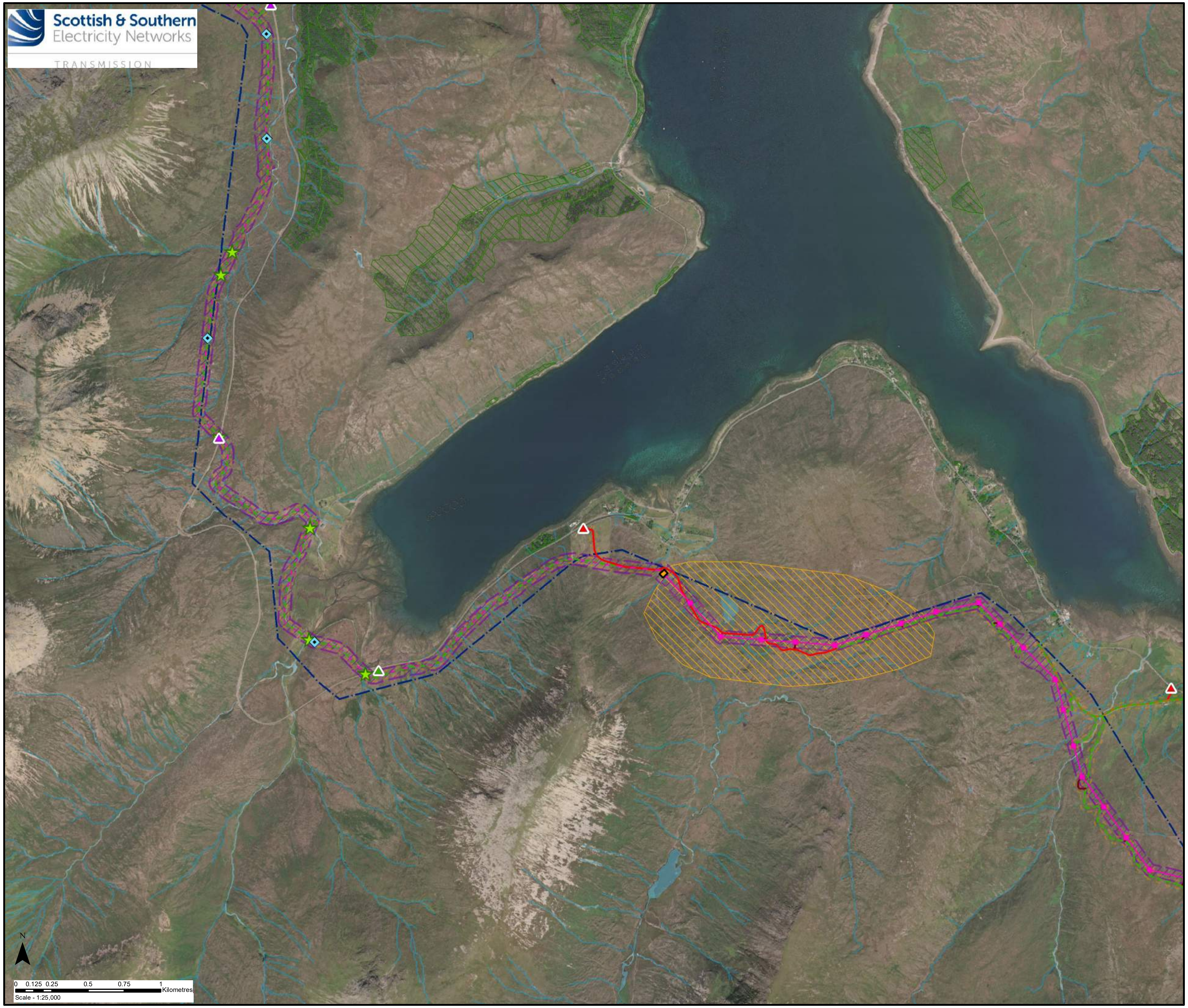
Project No: LT91

Project: Skye Reinforcement Project EIA Report

Title: Figure V2-7.2.1 Geomorphology Plan Map 8 - Sections 1 & 2

Drawn by: AA Date: 14/06/2023

Drawing: 04707.00020.0158.0



Key

- Proposed OHL Alignment
- Proposed Underground Cable
- Proposed Steel Lattice Tower
- Indicative Cable Link Box
- Horizontal Directional Drill (HDD) Location (Indicative)
- Limit of Deviation (OHL / Underground Cable)
- Existing 132 kV OHL to be Dismantled (Wood Pole)
- Existing Access Track to be Upgraded
- New Permanent Access Track (construction type to be determined)
- New Temporary Access Track
- New Temporary Spur to Towers
- Existing Bellmouth
- New Bellmouth
- Temporary Bellmouth
- Limit of Deviation (Access Tracks)
- Sealing End Compound
- Watercourse
- Waterbody
- Woodland
- Area of Peat Hagging

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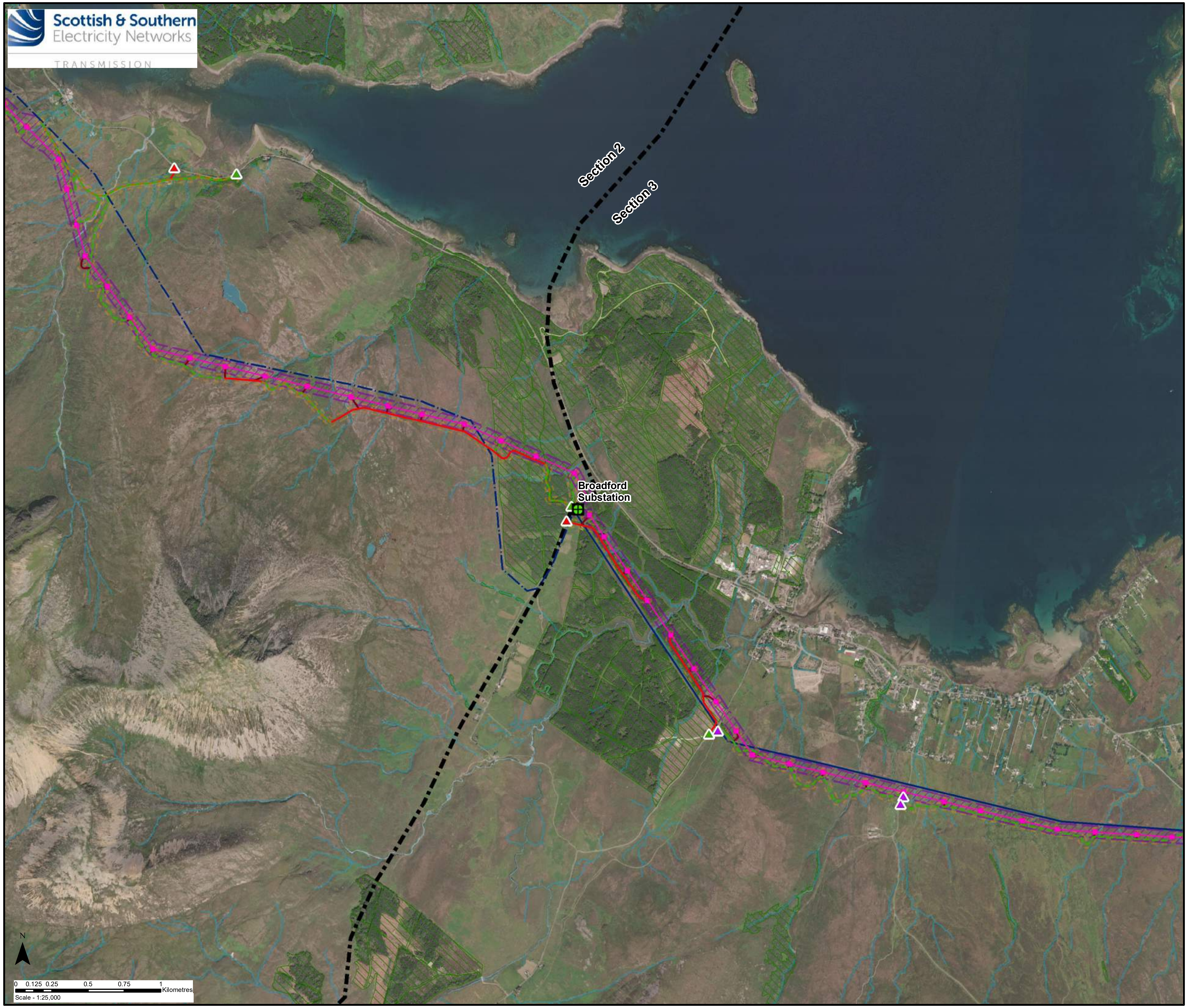
Project No: LT91

Project: Skye Reinforcement Project EIA Report

Title: Figure V2-7.2.1 Geomorphology Plan Map 9 - Section 2

Drawn by: AA Date: 14/06/2023

Drawing: 04707.00020.0158.0



Key

- Proposed OHL Alignment
- Proposed Steel Lattice Tower
- Limit of Deviation (OHL / Underground Cable)
- Existing 132 kV OHL to be Dismantled (Steel Lattice)
- Existing 132 kV OHL to be Dismantled (Wood Pole)
- Existing Access Track to be Upgraded
- New Permanent Access Track (construction type to be determined)
- New Temporary Access Track
- New Temporary Spur to Towers
- Existing Bellmouth
- New Bellmouth
- Temporary Bellmouth
- Limit of Deviation (Access Tracks)
- Existing Substation to be Extended (separate application)
- Watercourse
- Waterbody
- Woodland

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Project No: LT91

Project: Skye Reinforcement Project EIA Report

Title: Figure V2-7.2.1 Geomorphology Plan Map 10 - Sections 2 & 3

Drawn by: AA Date: 14/06/2023

Drawing: 04707.00020.0158.0

Key

- Proposed OHL Alignment
- Proposed Steel Lattice Tower
- Limit of Deviation (OHL / Underground Cable)
- Existing 132 kV OHL to be Dismantled (Steel Lattice)
- Existing Access Track
- Existing Access Track to be Upgraded
- New Permanent Access Track (Floating Construction)
- New Permanent Access Track (construction type to be determined)
- New Temporary Access Track
- New Temporary Spur to Towers
- Existing Bellmouth
- New Bellmouth
- Temporary Bellmouth
- Limit of Deviation (Access Tracks)
- Watercourse
- Waterbody
- Woodland
- Area of Peat Hagging

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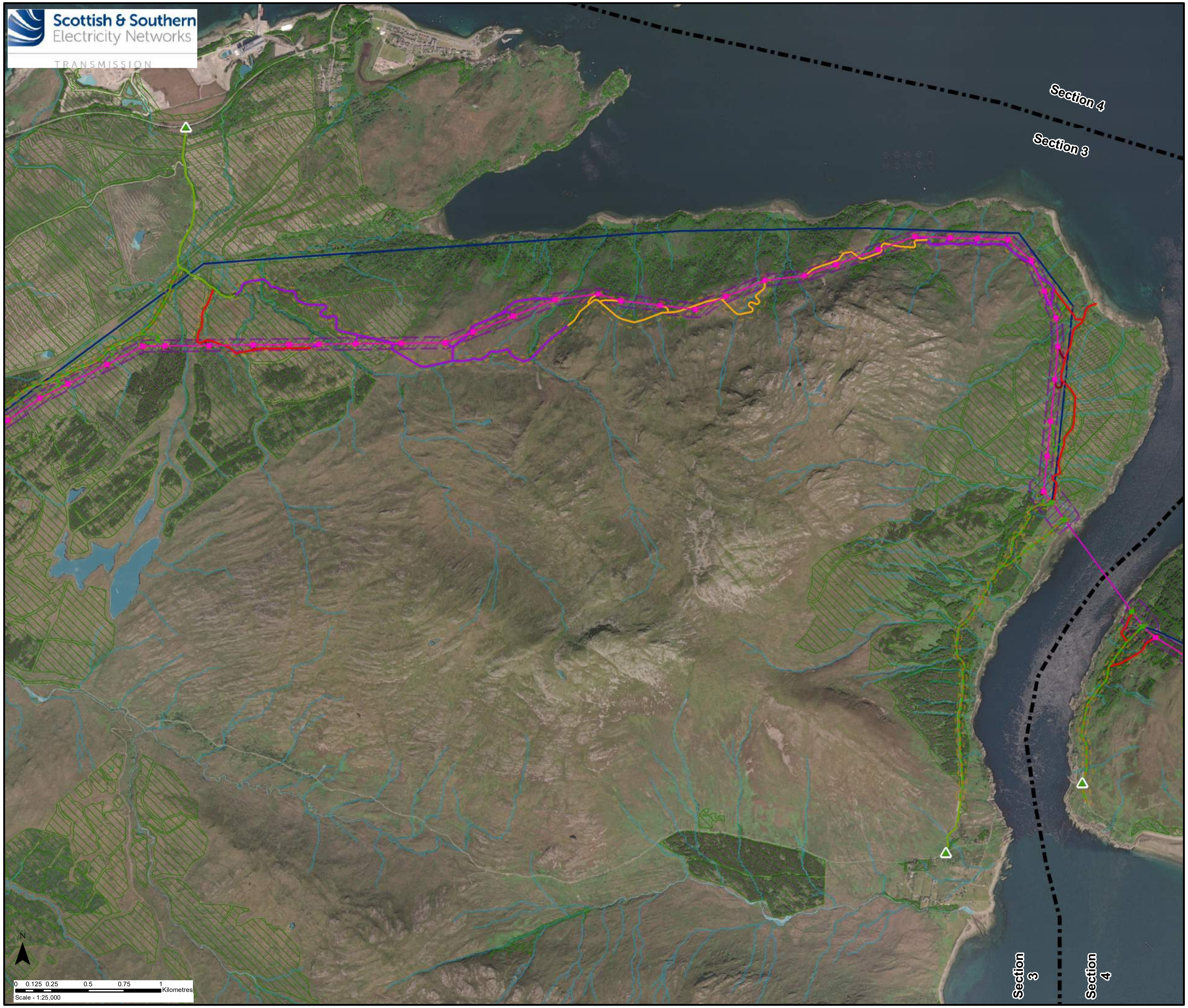
Project No: LT91

Project: Skye Reinforcement Project EIA Report

Title: Figure V2-7.2.1 Geomorphology Plan Map 11 - Section 3

Drawn by: AA Date: 14/06/2023

Drawing: 04707.00020.0158.0



Key

- Proposed OHL Alignment
- Proposed Steel Lattice Tower
- Existing Steel Lattice Tower to be Retained
- Limit of Deviation (OHL / Underground Cable)
- Existing 132 kV OHL to be Dismantled (Steel Lattice)
- Existing Access Track
- Existing Access Track to be Upgraded
- New Permanent Access Track (Cut / Fill Construction)
- New Permanent Access Track (Floating Construction)
- New Permanent Access Track (construction type to be determined)
- New Temporary Access Track
- New Temporary Spur to Towers
- Existing Bellmouth
- Limit of Deviation (Access Tracks)
- Watercourse
- Waterbody
- Woodland

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Project: Skye Reinforcement Project EIA Report

Title: Figure V2-7.2.1 Geomorphology Plan Map 12 - Sections 3 & 4

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Drawing: 04707.00020.0158.0

Key

- Proposed OHL Alignment
- Proposed Steel Lattice Tower
- Existing Steel Lattice Tower to be Retained
- Limit of Deviation (OHL / Underground Cable)
- Existing 132 kV OHL to be Dismantled (Steel Lattice)
- Existing Access Track
- Existing Access Track to be Upgraded
- New Permanent Access Track (Floating Construction)
- New Permanent Access Track (construction type to be determined)
- New Temporary Access Track
- New Temporary Spur to Towers
- Existing Bellmouth
- New Bellmouth
- Limit of Deviation (Access Tracks)
- Watercourse
- Waterbody
- Woodland

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Project: Skye Reinforcement Project
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Title: Figure V2-7.2.1
Geomorphology Plan
Map 13 - Sections 3 & 4

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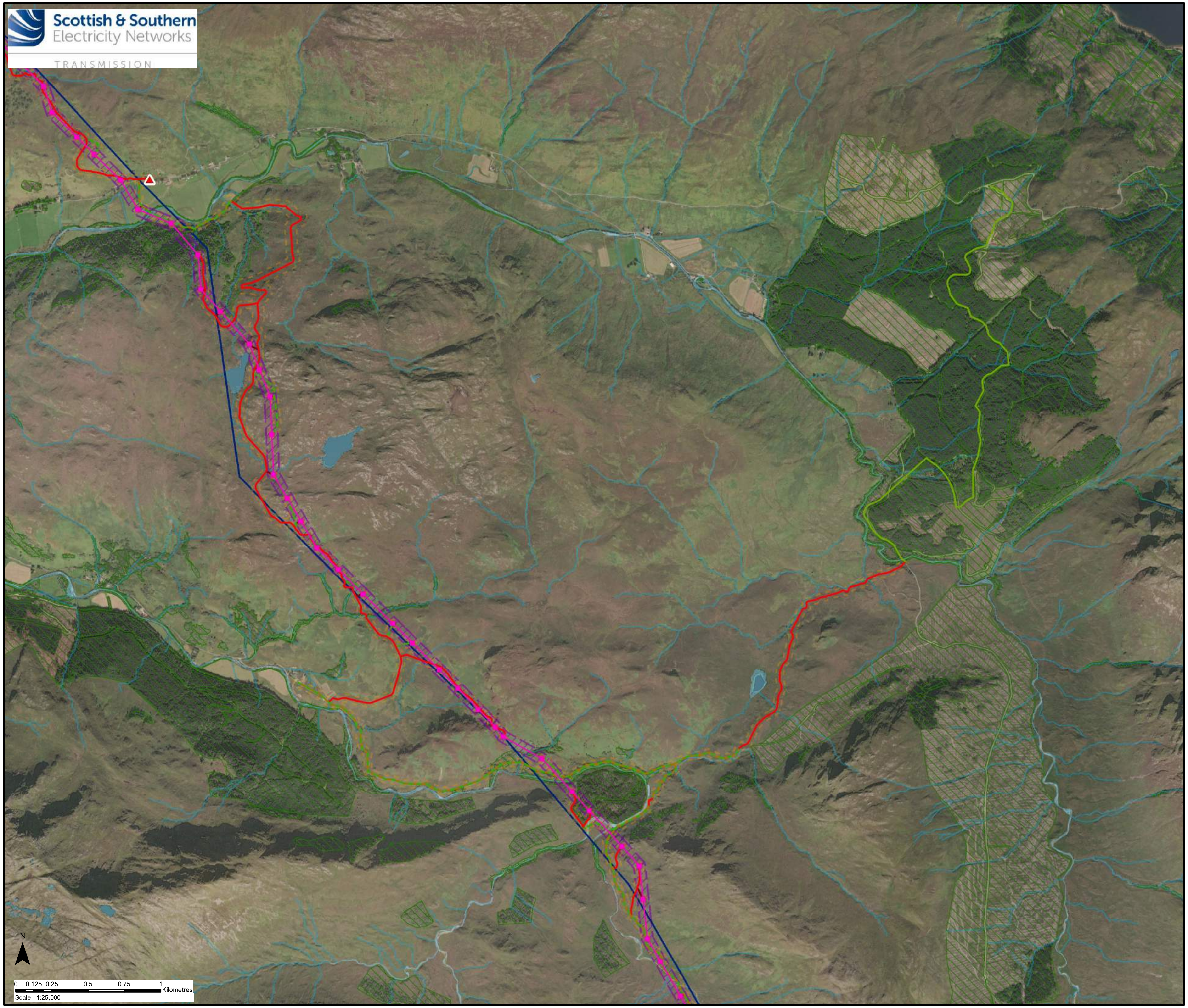
Drawing: 04707.00020.0158.0



Key

- Proposed OHL Alignment
- Proposed Steel Lattice Tower
- Limit of Deviation (OHL / Underground Cable)
- Existing 132 kV OHL to be Dismantled (Steel Lattice)
- Existing Access Track
- Existing Access Track to be Upgraded
- New Permanent Access Track (construction type to be determined)
- New Temporary Access Track
- New Temporary Spur to Towers
- New Bellmouth
- Limit of Deviation (Access Tracks)
- Watercourse
- Waterbody
- Woodland

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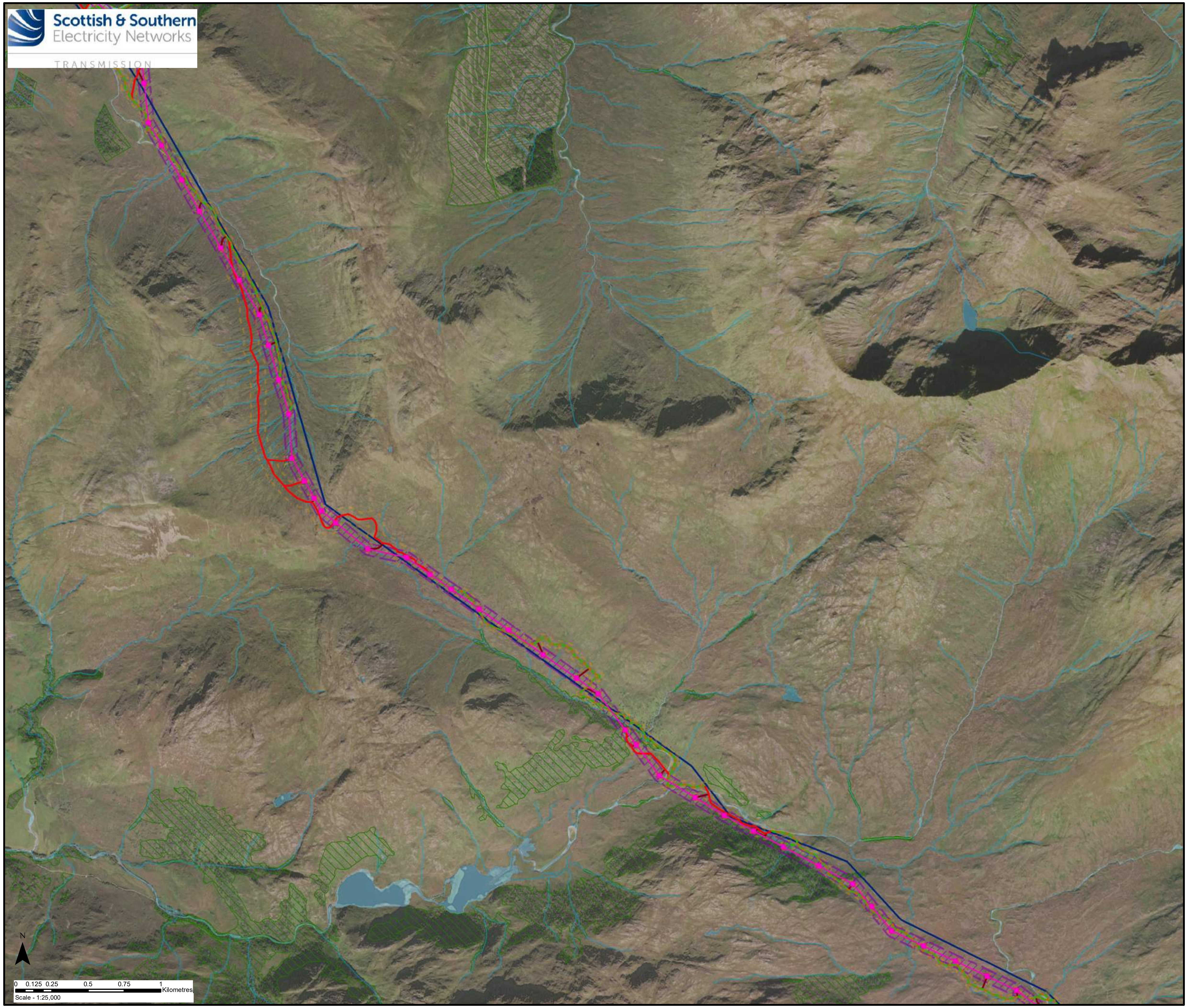
Project No: LT91

Project: Skye Reinforcement Project
EIA Report

Title: Figure V2-7.2.1
Geomorphology Plan
Map 14 - Section 4

Drawn by: AA Date: 14/06/2023

Drawing: 04707.00020.0158.0



Key

- Proposed OHL Alignment
- Proposed Steel Lattice Tower
- Limit of Deviation (OHL / Underground Cable)
- Existing 132 kV OHL to be Dismantled (Steel Lattice)
- Existing Access Track to be Upgraded
- New Permanent Access Track (construction type to be determined)
- New Temporary Access Track
- New Temporary Spur to Towers
- Limit of Deviation (Access Tracks)
- Watercourse
- Waterbody
- Woodland

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Project No: LT91

Project: Skye Reinforcement Project EIA Report

Title: Figure V2-7.2.1 Geomorphology Plan Map 15 - Section 4

Drawn by: AA Date: 14/06/2023

Drawing: 04707.00020.0158.0

Key

- Proposed OHL Alignment
- Proposed Steel Lattice Tower
- Limit of Deviation (OHL / Underground Cable)
- Existing 132 kV OHL to be Dismantled (Steel Lattice)
- Existing Access Track to be Upgraded
- New Permanent Access Track (construction type to be determined)
- New Temporary Access Track
- New Temporary Spur to Towers
- Existing Bellmouth
- New Bellmouth
- Temporary Bellmouth
- Limit of Deviation (Access Tracks)
- Watercourse
- Waterbody
- Woodland

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Project No: LT91

Project: Skye Reinforcement Project
EIA Report

Title: Figure V2-7.2.1
Geomorphology Plan
Map 16 - Section 4

Drawn by: AA Date: 14/06/2023

Drawing: 04707.00020.0158.0