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Technical Appendix 10.5: Groundwater Dependent Terrestrial Ecosystem Assessment

TECHNICAL APPENDIX 10.5: GROUNDWATER DEPENDENT TERRESTRIAL ECOSYSTEMS ASSESSMENT

10.1 Introduction

10.1.1 This Technical Appendix provides a summary of the Ground Water Dependant Terrestrial Ecosystems (GWDTEs) that may be affected by the Proposed Development. It should be read in conjunction with **EIAR Volume 2** in particular **Chapter 2: Description of Proposed Development (EIAR Volume 2)** for details of the Proposed Development, **Chapter 8: Ecology (EIAR Volume 2)** and **Chapter 10: Hydrology, Hydrogeology, Geology and Soils (EIAR Volume 2).**

10.1.2 This Technical Appendix provides a description of the bedrock and superficial geology and considers National Vegetation Classification (NVC) and peat surveys that have been completed, and identifies from this data which habitats have the potential to be GWDTEs. The document, therefore, then presents a hydrogeological and hydrological assessment of these potential GWDTE habitats, taking into account underlying geological conditions or connectivity to surface water contribution, in order to assess the groundwater dependency.

10.2 Legislation

10.2.1 The principal legislation regarding the water environment is provided by the EU Water Framework Directive (WFD[1]) which aims to protect and enhance the quality of surface freshwater (including lakes, rivers, and streams), groundwater, Groundwater Dependent Terrestrial Ecosystems (GWDTEs), estuaries and coastal waters.

10.2.2 The key objectives of the WFD relevant to this assessment are:

- To prevent deterioration and enhance aquatic ecosystems; and
- To establish a framework for protection of surface freshwater and groundwater.

10.2.3 The WFD resulted in the Water Environment and Water Services (Scotland) Act 2003 (WEWS Act[2]), which gives Scottish Ministers powers to introduce regulatory controls over water activities to protect, improve and promote sustainable use of Scotland's water environment.

10.2.4 The protection of GWDTEs in Scotland is regulated within the Water Environment (Controlled Activities) (Scotland) Regulations 2011[3] (as amended) (CAR).

10.3 Methodology

Field Survey

10.3.1 NVC surveys[4] were completed to identify potential GWDTEs[5] based on the vegetation present. The NVC surveys followed the methodology described in best practice guidance[6], with five 2 m^2 quadrats surveyed within each habitat area, and the species composition analysed. Surveys were undertaken by Ramboll ecologists in October 2021 and February 2022.

[1] European Commission. The EU Water Framework Directive – integrated river basin management for Europe. https://ec.europa.eu/environment/water/water-framework/index_en.html
[2] Water Environment and Water Services (Scotland) Act 2003. https://www.legislation.gov.uk/asp/2003/3/contents
[3] https://www.legislation.gov.uk/ssi/2011/209/contents/made
[4] Rodwell, J.S., (2006), *National Vegetation Classification: User's Handbook*. Peterborough: JNCC.
[5] Guidance on Assessing the Impacts of Wind farm Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems (2014), URL: https://www.sepa.org.uk/media/143868/lupsgu31_planning_guidance_on_groundwater_abstractions.pdf [4th August 2022].
[6] Rodwell, J.S., (2006), *National Vegetation Classification: User's Handbook*. Peterborough: JNCC.

Desk Study

10.3.2 The baseline hydrology and geology of the Site has been characterised as part of the EIAR and is detailed in Section 10.5 of **Chapter 10: Hydrology, Hydrogeology, Geology and Soils (EIAR Volume 2).** A summary is provided in this Technical Appendix.

10.3.3 Analysis of the hydrological regime of areas identified as having the potential to be groundwater dependent was carried out through the use of the ESRI ArcGIS Pro hydrological toolset. This tool provides methods for describing the physical components of a surface, allowing identification of sinks (areas where surface water could pond), determination of likely flow direction and routes where flow accumulation would occur, delineation of watersheds, and mapping of stream networks (**Figure 10.6: Habitats with the Potential to be Groundwater Dependent Terrestrial Ecosystems – National Vegetation Classification (EIAR Volume 3a)**).

10.3.4 The methodology for assessing the potential disruption to GWDTEs is outlined in the Scottish Environment Protection Agency (SEPA) Land Use Planning System Guidance Note 31: Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems[7].

Limitations and Assumptions

10.3.5 This assessment relies on datasets provided by parties other than Ramboll and it is assumed these are datasets are accurate and reliable.

10.3.6 The habitat and faunal surveys provide a snapshot of ecological conditions and do not record plants or animals that may be present in the field survey area at different times of the year. The absence of a particular species cannot necessarily be confirmed by a lack of field signs and only concludes that an indication of its presence was not located during the survey effort.

10.3.7 Hydrological surveying for the Watercourse Crossing Assessment (**Technical Appendix 10.4: Watercourse Crossing Assessment (EIAR Volume 4**) provided assessment of surface water features and indicative hydrological conditions within the Site (at accessible locations), however hydrology surveying did not include site-specific assessment of potential GWDTE areas.

10.4 Baseline Conditions

Surface Water Features

10.4.1 The Site falls within a 50 m buffer of a number of watercourses, lochs, lochans, and at a number of locations crosses such features. The watercourses vary from smaller hillside streams and burns, to larger meandering watercourses several meters wide.

10.4.2 Overall, the Western Isles can be characterised as containing extensive peatlands with many bogs, lochs, burns and surface water drainage features. A lack of woodland means surface water runoff is high and the peatland holds a high reservoir of water[8].

10.4.3 Surface water features are shown in **Figure 10.1: Surface Water Features (EIAR Volume 3a)**.

Geology and Hydrogeology

10.4.4 According to the BGS bedrock geology mapping, north of Arivruaich the Proposed Development is underlain by Mylonitic rock and fault breccia of the Outer Hebridies Thrust Zone Mylonites Complex. South of this point the Proposed Development is underlain by Lewisian Gneiss, with the final section of the Proposed Development south of Tarbet underlain by unnamed igneous intrusions and an outcrop of Lewisian Gneiss. Bedrock geology is shown in **Figure 10.3: Bedrock Geology (EIAR Volume 3a).**

[7] https://www.sepa.org.uk/media/144266/lups-gu31-guidance-on-assessing-the-impacts-of-development-proposals-on-groundwater-abstractions-and-groundwater-dependent-terrestrial-ecosystems.pdf

[8] NatureScot. Landscape Character Assessment: Outer Hebrides – Landscape Evolution and Influences. https://www.nature.scot/doc/landscape-character-assessment-outer-hebrides-landscape-evolution-and-influences

10.4.5 Along the length of the Proposed Development, the superficial geology is limited in extent. The BGS mapping indicates overlying peat in the north of the Site near Stornoway, and glacial till deposits near Arivruaich, Ardvourlie and south of Tarbert near the Harris Grid Supply Point (GSP). Superficial geology is shown in **Figure 10.4: Superficial Geology (EIAR Volume 3a).**

10.4.6 According to BGS 1:625,000 scale hydrogeological mapping, the entire Proposed Development is underlain by aquifers of a Low Productivity (**Figure 10.5: Hydrogeology (EIAR Volume 3a)**), in which flow is virtually all through fractures and other discontinuities. Aquifers underlying the Site are considered unlikely to support public water supplies, or to have the potential to do so.

10.5 Groundwater Dependent Terrestrial Ecosystems

10.5.1 Excavation of soil and bedrock during the construction phase of the Proposed Development may cause localised disruption and interruption to groundwater flow. Interruption of groundwater flow could potentially reduce the supply of groundwater to GWDTEs, thereby causing an alteration or change in the quality and / or quantity of groundwater, and / or a change in the physical or biological characteristics of the GWDTE. Contamination of groundwater may also cause physical or chemical contamination to the GWDTE.

10.5.2 Following identification of potential GWDTEs from NVC mapping, hydrological and hydrogeological desktop study information has been used to qualitatively determine the potential dependence of each habitat on groundwater.

10.5.3 The potential for a habitat to be groundwater dependent, and therefore the sensitivity of each potential GWDTE habitat, has been based upon classifications provided within the SEPA guidance document LUPS-GN31.

10.5.4 **Table 10.5.1** sets out the predominant NVC communities encountered across the Site with the potential to be GWDTE following the detailed NVC survey carried out in October 2021 and February 2022. The GWDTE classification of each GWDTE receptor (i.e. Highly / Moderately groundwater dependent habitat) has been classified in accordance with SEPAs guidance LUPS-GN31. The SEPA classification is modified from UKTAG (2008)[9] list of NVC communities, which provides the full list for all communities. The relevant UKTAG classification is also provided.

Table 10.5.1: NVC Communities Present and their Potential Groundwater Dependency according to SEPA NVC Classification

NVC Community Present	Initial Potential GWDTE Classification
M21	High
M15c	Moderate
MG10a	Moderate
M25	Moderate
M15c	Moderate

10.6 Groundwater Dependency

Introduction

10.6.1 UKTAG guidance (2004) recognises that most *"water dependent terrestrial ecosystems lie along a continuum between always only groundwater dependent and always only surface water dependent […]. The source of water supply for some wetlands does not appear to be critical, therefore the task of identifying dependence upon groundwater is sometimes complex"*.

10.6.2 SNIFFER (2007) guidance[10] states that the dependence of wetlands on groundwater bodies is a result of hydrological connectivity. The degree of dependency will vary depending on whether the wetland is underlain by a

[9] Guidance within GN31 is adapted from 'UK Technical Advisory Group list of NVC communities and associated groundwater dependency scores (2008)
[10] SNIFFER (2007) WFD66 – Wetland Hydrogeomorphic Classification for Scotland. Edinburgh: SNIFFER.

low productivity or high productivity aquifer and whether there is a hydrological linkage mechanism between groundwater and the surface wetland. Likelihood of dependency is based upon the following:

- High Likelihood: characterised by intergranular, high productivity drift aquifer and dominantly intergranular, highly productive aquifer;
- Moderate Likelihood: characterised by intergranular, moderate productivity drift aquifer and fractured, very low productivity aquifer; and
- Low Likelihood: characterised by intergranular, very low productivity drift aquifer and fractured, very low productivity aquifer.

10.6.3 Following the initial identification of habitats with the potential to be GWDTEs from NVC mapping (**Figure 10.8: Habitats with the Potential to be Groundwater Dependent Terrestrial Ecosystems – National Vegetation Classification (EIAR Volume 3a)**), Ramboll hydrologists assessed the site-specific conditions and hydrological context of potential GWDTEs to qualitatively determine the groundwater dependency of potential GWDTEs.

10.6.4 The assessment included consideration of:

- the direct hydrological connection of a potential GWDTE to surface water sources;
- underlying geological conditions including the productivity of bedrock and superficial geology, the presence of peat souls and permeability of upgradient geology;
- topography and the presence of rill or runnels indicative of surface runoff;
- the presence of indicative 'flush' patterns of vegetation communities; and
- land use.

10.6.5 Where GWDTE features are found to be in direct connectivity to surface water features they are considered to have a lower likelihood of groundwater dependency.

Terrain

10.6.6 The GWDTE habitats dominate the Site south of Ardvourlie. This section of the route is characterised as having steep hillslopes on either side of the primary access road (**Figure 10.5.1: Topography**). This terrain would dictate that a high level of surface water runoff will be flowing downslope across the habitats identified as being potentially groundwater dependent. This conclusion is supported by the ESRI ArcGIS Pro hydrological toolset stream network modelling (see next section).

Hydrological Analysis

10.6.7 Based on 5 m resolution Digital Terrain Model (DTM) surface terrain data, a flow accumulation tool was to generate likely surface water runoff flow paths based on the predicted flow direction of surface waters. Combined with the OS 1:10,000 scale mapping of watercourses, the hydrological analysis predicts that the majority of the potentially High and Moderate GWDTE habitats, particularly in the southern half of the route (south of Ardvourlie) are either adjacent to watercourses or likely surface water flow/accumulation paths (**Figure 10.8: Habitats with the Potential to be Groundwater Dependent Terrestrial Ecosystems - National Vegetation Classification (EIAR Volume 3a)**).

10.6.8 This indicates that the topography of the Site is such that there are areas where surface waters could accumulate and these often correlate with the areas of habitat which were initially indicated to have the potential to be GWDTEs. It is, therefore, considered that these surface water flows are likely to present a greater source of water input to the habitat than groundwater. On this basis, the majority of the potentially High and Moderate GWDTEs are not considered to be dependent on groundwater.

Geology and Hydrogeology

10.6.9 The underlying bedrock geology is metamorphic and igneous formations where water flow through the rock would be very limited. In addition, the underlying bedrock aquifer is assessed by the BGS to be of Low productivity with limited groundwater in the near surface weathered zone and secondary fractures. Therefore, it is considered likely that the majority of the potential GWDTEs within the Site are not fed by a groundwater aquifer. This is supported by the presence of GWDTEs being in direct connection to overland flows and the assessment of local topography which predicts surface water run-off downslope through the areas identified as having a High to Moderate potential of being groundwater dependent.

10.6.10 The areas of potential Moderate GWDTE in the northern section of the route between Ballallan and Stornoway are recorded on areas of deeper peat (between approximately 3-4 m). Water retention of the peaty soils would again support the assumption that the GWDTE habitats are not groundwater dependent but are fed by near surface flows and are likely to be ombrogenous (rain fed), with the habitats forming as a result of saturation following rainfall and not supported by a groundwater feed.

Land Use

10.6.11 Many of the GWDTE habitats particularly in the northern section of the route between Ballallan and Stornoway are located in areas of rough, open peatland. These areas are characterised by habitats which are waterlogged. A review of aerial imagery also indicates the habitats in the northern section of the route coincide with areas potentially harvested for peat, and/or where drainage ditches have been cut. These drainage gullies would form preferential flow paths and areas of surface water runoff collection where the NVC communities are likely to develop.

Summary

10.6.12 A contribution from groundwater cannot be entirely ruled out for all the GWDTEs identified through the NVC survey; however, based on the above analysis the majority of the habitats are not considered groundwater dependent due to their correlation with watercourses, surface water runoff flowpaths, areas of altered drainage, peatlands and based on the underlying geology and hydrogeology.

10.7 Sensitivity of Groundwater Dependent Habitats

10.7.1 The UKTAG (2004) guidance provides criteria for identification and inclusion of GWDTEs in the risk assessment process, based on complementary ecological and hydrogeological assessments. These criteria have been used to produce the following matrix (**Table 10.5.2**), which provides an identification of sensitive and potentially sensitive GWDTEs that require a qualitative assessment to ascertain the significance of the risks the Proposed Development poses to them.

Table 10.5.2: Matrix for Identification of Sensitive GWDTEs from Ecological and Hydrogeological Assessment

		Hydrogeological Assessment of Groundwater Dependency		
		High Likelihood	**Moderate Likelihood**	**Low Likelihood**
Ecological Assessment of NVC Communities	**High groundwater dependency**	Sensitive GWDTE	Potentially sensitive GWDTE	Potentially sensitive GWDTE
	Moderate groundwater dependency	Potentially sensitive GWDTE	Potentially sensitive GWDTE	Not sensitive
	Not groundwater dependent	Potentially sensitive GWDTE	Not sensitive	Not sensitive

10.7.2 The hydrogeological assessment of groundwater dependency based on the NVC survey concluded that the likelihood of groundwater dependency is considered to be low for all potential GWDTEs across the Site. This is in line with the topography; land use; hydrological; and hydrogeological conditions. Therefore, according to the matrix in **Table 10.5.2**, the areas indicated to be of High groundwater dependency based on the NVC survey are potentially sensitive, and the Moderate groundwater dependent habitats based on the NVC survey are not sensitive.

10.8 Mitigation Measures and Recommendations

10.8.1 The majority of the GWDTE areas are assessed as not being groundwater dependent, but instead reliant on surface water runoff. Therefore, it is considered that the maintenance of surface water quality and quantity and distribution to these habitats is important. Measures to ensure the continued supply of surface waters and prevent impacts to water quality are provided in **Chapter 10: Hydrology, Hydrogeology, Geology and Soils (EIAR Volume 2).**

10.8.2 Drainage measures that will maintain hydrological connectivity and ensure water quality would be implemented via the final Construction Environmental Management Plan (CEMP) to be developed by the Appointed Contractor. However, mitigation measures may include the following:

- implementation of Sustainable Drainage System (SuDS) measures to maintain quality of water supply during the construction phase of the Proposed Development;
- maintenance of flow paths/ redistribution of water where diverted;
- implementation of pollution control measures; and
- the Appointed Contractor to follow relevant SSEN Transmission's General Environment Management Plans (GEMPs), SEPA best practice guidance, and produce Pollution Prevention Plans (PPPs) prior to works.

10.8.3 Direct loss of sensitive habitats identified as not being groundwater dependent and / or peatland habitats are assessed in **Chapter 8: Ecology (EIAR Volume 2)** and **Chapter 10: Hydrology, Hydrogeology, Geology and Soils (EIAR Volume 2)** respectively.

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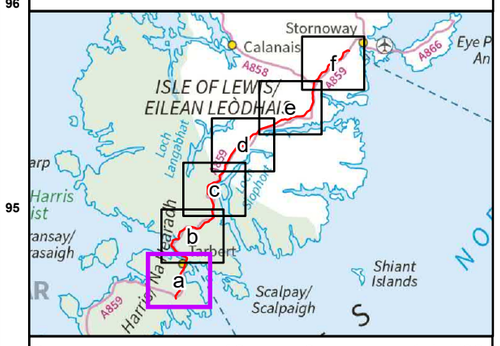
Legend

- Proposed Alignment
- Indicative Pole Location
- Harris 132kV Grid Supply Point

Terrain Height (mAOD)

-3.8 - 0.0	250.0 - 275.0
0.0 - 25.0	275.0 - 300.0
25.0 - 50.0	300.0 - 325.0
50.0 - 75.0	325.0 - 350.0
75.0 - 100.0	350.0 - 375.0
100.0 - 125.0	375.0 - 400.0
125.0 - 150.0	400.0 - 425.0
150.0 - 175.0	425.0 - 450.0
175.0 - 200.0	450.0 - 475.0
200.0 - 225.0	475.0 - 500.0
225.0 - 250.0	

Scale @ A3: 1:30,000
0 0.175 0.35 0.7 1.05 1.4 1.75 km



Project No: LT0245

Project: Harris to Stornoway 132 kV OHL Replacement

Title: Figure 10.5.1a: Topography

Drawn by: AB Date: 02/09/2022

Drawing: R162_11469_001_Fig10-5-1_Topography_A

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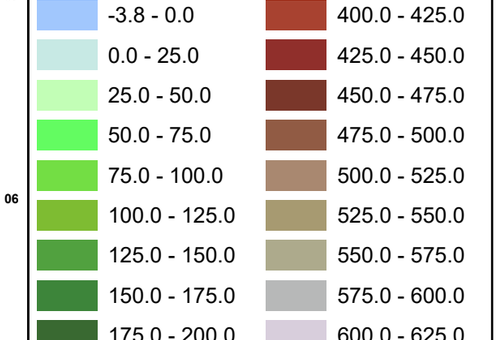
TRANSMISSION

Legend

- Proposed Alignment
- Indicative Pole Location

Terrain Height (mAOD)

-3.8 - 0.0	400.0 - 425.0
0.0 - 25.0	425.0 - 450.0
25.0 - 50.0	450.0 - 475.0
50.0 - 75.0	475.0 - 500.0
75.0 - 100.0	500.0 - 525.0
100.0 - 125.0	525.0 - 550.0
125.0 - 150.0	550.0 - 575.0
150.0 - 175.0	575.0 - 600.0
175.0 - 200.0	600.0 - 625.0
200.0 - 225.0	625.0 - 650.0
225.0 - 250.0	650.0 - 675.0
250.0 - 275.0	675.0 - 700.0
275.0 - 300.0	700.0 - 725.0
300.0 - 325.0	725.0 - 750.0
325.0 - 350.0	750.0 - 775.0
350.0 - 375.0	775.0 - 802.0
375.0 - 400.0	



Project No: LT0245

Project: Harris to Stornoway 132 kV OHL Replacement

Title: Figure 10.5.1b: Topography

Drawn by: AB Date: 02/09/2022

Drawing: R162_11469_001_Fig10-5-1_Topography_A

Scale @ A3: 1:30,000

0 0.175 0.35 0.7 1.05 1.4 1.75 km

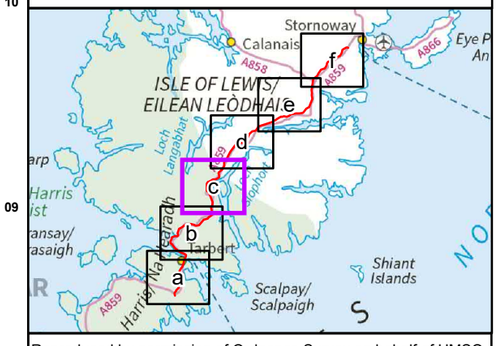
Scottish & Southern Electricity Networks
TRANSMISSION

Legend

- Proposed Alignment
- Indicative Pole Location

Terrain Height (mAOD)

-3.8 - 0.0	400.0 - 425.0
0.0 - 25.0	425.0 - 450.0
25.0 - 50.0	450.0 - 475.0
50.0 - 75.0	475.0 - 500.0
75.0 - 100.0	500.0 - 525.0
100.0 - 125.0	525.0 - 550.0
125.0 - 150.0	550.0 - 575.0
150.0 - 175.0	575.0 - 600.0
175.0 - 200.0	600.0 - 625.0
200.0 - 225.0	625.0 - 650.0
225.0 - 250.0	650.0 - 675.0
250.0 - 275.0	675.0 - 700.0
275.0 - 300.0	700.0 - 725.0
300.0 - 325.0	725.0 - 750.0
325.0 - 350.0	750.0 - 775.0
350.0 - 375.0	775.0 - 802.0
375.0 - 400.0	



Project No: LT0245

Project: Harris to Stornoway 132 kV OHL Replacement

Title: Figure 10.5.1c: Topography

Drawn by: AB Date: 02/09/2022

Drawing: R162_11469_001_Fig10-5-1_Topography_A

Scale @ A3: 1:30,000
0 0.175 0.35 0.7 1.05 1.4 1.75 km

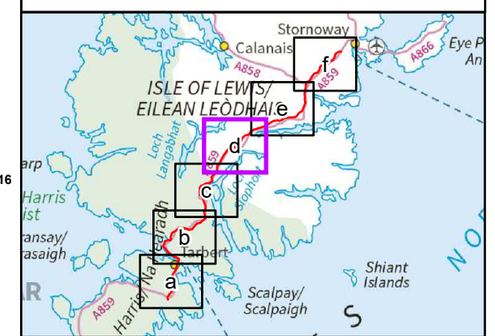
Scottish & Southern Electricity Networks
TRANSMISSION

Legend

- Proposed Alignment
- Indicative Pole Location

Terrain Height (mAOD)

-3.8 - 0.0	200.0 - 225.0
0.0 - 25.0	225.0 - 250.0
25.0 - 50.0	250.0 - 275.0
50.0 - 75.0	275.0 - 300.0
75.0 - 100.0	300.0 - 325.0
100.0 - 125.0	325.0 - 350.0
125.0 - 150.0	350.0 - 375.0
150.0 - 175.0	375.0 - 400.0
175.0 - 200.0	



Project No: LT0245

Project: Harris to Stornoway 132 kV OHL Replacement

Title: Figure 10.5.1d: Topography

Drawn by: AB Date: 02/09/2022

Drawing: R162_11469_001_Fig10-5-1_Topography_A

Scale @ A3: 1:30,000

0 0.175 0.35 0.7 1.05 1.4 1.75 km

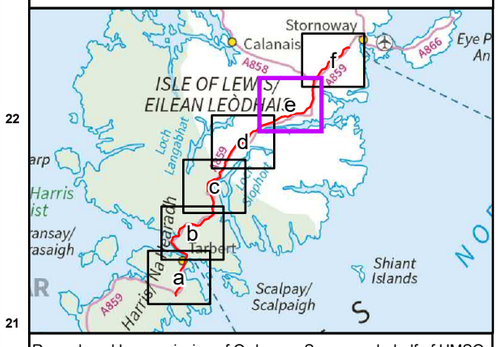
Scottish & Southern Electricity Networks
TRANSMISSION

Legend

- Proposed Alignment
- Indicative Pole Location

Terrain Height (mAOD)

-3.8 - 0.0	75.0 - 100.0
0.0 - 25.0	100.0 - 125.0
25.0 - 50.0	125.0 - 150.0
50.0 - 75.0	



Project No: LT0245

Project: Harris to Stornoway 132 kV OHL Replacement

Title: Figure 10.5.1e: Topography

Drawn by: AB

Date: 02/09/2022

Drawing: R162_11469_001_Fig10-5-1_Topography_A

Scale @ A3: 1:30,000

0 0.175 0.35 0.7 1.05 1.4 1.75 km

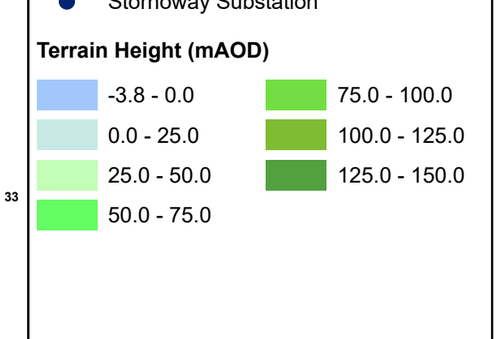
Scottish & Southern Electricity Networks
TRANSMISSION

Legend

- Proposed Alignment
- Indicative Pole Location
- Stornoway Substation

Terrain Height (mAOD)

- -3.8 - 0.0
- 0.0 - 25.0
- 25.0 - 50.0
- 50.0 - 75.0
- 75.0 - 100.0
- 100.0 - 125.0
- 125.0 - 150.0



Project No: LT0245

Project: Harris to Stornoway 132 kV OHL Replacement

Title: Figure 10.5.1f: Topography

Drawn by: AB

Date: 02/09/2022

Drawing: R162_11469_001_Fig10-5-1_Topography_A

Scale @ A3: 1:30,000

0 0.175 0.35 0.7 1.05 1.4 1.75 km