

Creag Dhubh to Dalmally 275kV Connection
Environmental Impact Assessment
Volume 4 | Technical Appendix 10.6

Forestry Hydrology Assessment

May 2022



CONTENTS

LIST OF ABBREVIATIONS	2
1 INTRODUCTION	3
1.1 The Proposals	3
1.2 Requirement for Forestry Hydrology Report.....	3
2 METHODOLOGY.....	5
2.1 Desk Study.....	5
2.2 Limitations and Assumptions	5
3 RESULTS.....	6
3.1 Desk Study.....	6
4 ASSESSMENT	9
APPENDIX A – FIGURES	10

List of Abbreviations

BGS	British Geological Survey
CIEEM	Chartered Institute of Ecology and Environmental Management
DTM	Digital Terrain Model
DWPA	Drinking Water Protected Area
EclA	Ecological Impact Assessment
ECoW	Environmental Clerk of Works
EIA	Environmental Impact Assessment
EIA Report	Environmental Impact Assessment Report
FEH	Flood Estimation Handbook
GWDTE	Groundwater Dependent Terrestrial Ecosystems
NVC	National Vegetation Classification
OHL	Overhead Line
SAC	Special Area of Conservation
SEPA	Scottish Environment Protection Agency
SNH	Scottish Natural Heritage
SSSI	Site of Special Scientific Interest

1 INTRODUCTION

1.1 The Proposals

- 1.1.1 This Technical Appendix (TA) presents information relevant to the Creag Dhubh to Dalmally 275kV Connection. It should be read in conjunction with the **Volume 2 – EIA Report** specifically **Chapter 10: Hydrology, Hydrogeology, Geology and Soils**, for full details of the Proposed Development.
- 1.1.2 Scottish Hydro Electric Transmission plc (the Applicant) who, operating and known as Scottish and Southern Electricity Networks Transmission (SSEN Transmission), own, operate and develop the high voltage electricity transmission system in the north of Scotland and remote islands. Due to the growth in renewable electricity generation in the north and north-east of Scotland, upgrade of the transmission network is required in order to provide the necessary increase in transmission capacity.
- 1.1.3 The Applicant is proposing to apply for consent under section 37 of the Electricity Act 1989 to construct and operate a 13.3 kilometre (km) double circuit 275 kV overhead line (OHL), supported by lattice steel towers between a proposed substation at Creag Dhubh to the existing Scottish Power Energy Networks (SPEN) 275 kV OHL that runs from Dalmally to Inverarnan, near Succoth Glen, connecting via a Tie-In connection (the 'Proposed Development'). The location of the Proposed Development is shown in **Figure 1.1: Location Plan and Overview (EIAR Volume 3a)**.

1.2 Requirement for Forestry Hydrology Report

- 1.2.1 The UK Forestry Standards Guidelines(UKFSG) (5th Ed)¹ sets out that, with regard to acidification of downstream watercourses, *“research shows that the effects of harvesting on surface water acidity are difficult to discern when 20% or less of a catchment is felled within any three-year period. Consequently, where the rate of felling exceeds this figure, it may be necessary to carry out a site impact assessment to determine if the watercourse is at risk; this includes felling for habitat restoration or windfarm developments”*.
- 1.2.2 Similarly, Guideline 34 of the UKFSG sets out that clear-felling of more than 20% of the catchment of a public water supply should be avoided within any three-year period.
- 1.2.3 It is also noted that *“Estuarine and coastal waters are less influenced by forestry due to dilution and other factors, but some water bodies are very sensitive to disturbance, such as designated shellfish waters in shallow marine lochs. Shellfish could be adversely affected by increased sediment and nutrient inputs associated with larger-scale forestry operations”*. The 20% threshold is also advised in Guideline 42 with regard to water bodies are sensitive to nutrient enrichment, including shallow coastal lochs designated for shellfish; i.e. seek to limit any clear-felling to less than 20% of the catchment in any three-year period.
- 1.2.4 The key receptors with regard to potential impacts from extensive forestry felling are:
- Public drinking water supplies
 - Shellfish Waters Protected Areas²
 - Flood Risk Areas
 - Catchments Sensitive to Acidification
 - Nitrate Sensitive Catchments

¹ https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/687147/The_UK_Forestry_Standard.pdf

² Shellfish water protected areas are areas designated for the protection of shellfish growth and production.

1.2.5 This assessment takes account of the felling requirements for the construction and operation of the Proposed Development, as well as the additional 'management felling'³ required to achieve windfirm edges. Further details on Forestry can be found in **Chapter 11: Forestry (EIAR Volume 2)**.

³ This felling is not included within the scope of the Proposed Development (for the purpose of the application for consent under S37 of the Electricity Act 1989). This additional 'management felling' would be subject to a requirement for separate felling licence approval from Scottish Forestry.

2 METHODOLOGY

2.1 Desk Study

- 2.1.1 The baseline hydrology and hydrogeology of the site has been characterised as part of the EIA and, where relevant, is summarised in this document.
- 2.1.2 The assessment utilised the following opensource datasets:
- Ordnance Survey (OS) 1:10,000 scale mapping;
 - Ordnance Survey OS Terrain 5 Digital Terrain Modelling (DTM);
 - BGS 1:625,000 Geological Mapping;
 - SEPA River Basin Management Plan; and
 - OS Open Rivers watercourse map.
- 2.1.3 Analysis of the hydrological regime of the study area 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 for 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. The flow paths and subsequent watershed delineation were used to identify the principal catchment areas through which the proposed OHL passes. The catchment areas have been verified using the Flood Estimation Handbook (FEH) web service⁴.
- 2.1.4 The catchments along the powerline route were then assessed to determine the potential for connectivity with downstream sensitivities, as listed in Section 1.3.

2.2 Limitations and Assumptions

- 2.2.1 Field data collected by parties other than Ramboll is relied upon and assessment derived from these data sets is based on the assumption that surveying has been carried out following best practice guidelines, in line with those employed by Ramboll.

⁴ Flood Estimation Handbook Web Service <https://fehweb.ceh.ac.uk/GB/map> [Accessed 26/11/21]

3 RESULTS

3.1 Desk Study

Catchment Areas

- 3.1.1 The northern limit of the Proposed Development is located within the River Orchy catchment, or within the catchment area of one of its tributaries. The catchment area of the River Orchy extends beyond the limits of the DTM used within this study. Therefore, the overall catchment area of 341 km² has been derived from the FEH Web Service. The River Orchy discharges into Loch Awe.
- 3.1.2 The majority of the Proposed Development passes through smaller catchments which similarly discharge into tributaries of Loch Awe including Teatle Water, Allt Eoinein, Allt Fearna and the Cladich River. These are much smaller in area than the River Orchy.
- 3.1.3 The southern limit of the Proposed Development lies within the upper limits of the catchment of the River Aray which does not flow to the northwest towards Loch Awe, as is the case for the other catchments, but drains in a general southerly or south-easterly direction into coastal waters at Loch Fyne.

Receptor Sensitivities

Public Drinking Water Supplies

- 3.1.4 Scottish Government has published mapping⁵ of Drinking Water Protected Areas (DWPAs). Parts of the catchment of the Cladich River with direct connectivity with the Proposed Development route are shown to be a DWPA. The DWPA itself extends to 0.74 km² in area as presented in **Appendix A (Figure 10.X.4)**. Although a SEPA reported dated 2019⁶ specifically states that the Cladich River is not used for drinking water storage (listed as heavily modified for hydropower generation) this appears erroneous. It is understood that this part of the River Cladich catchment is currently active in supplying the Cladich properties with drinking water. Scottish Water has confirmed that “the Cladich Intake catchment supplies Cladich Water Treatment Works (WTW) and it is essential that water quality and water quantity in the area are protected”.
- 3.1.5 There are no other DWPAs with direct surface water connectivity to the Proposed Development.

Shellfish Waters Protected Areas

- 3.1.6 The River Aray discharges into Loch Fyne which is designated as a Shellfish Water⁷ as presented in **Appendix A (Figure 10.X.5)**.

Flood Risk Areas

- 3.1.7 Any catchments which exceed 3 km² in area would be expected to be associated with downstream fluvial flood risk areas. Although these flood risk areas may currently be limited to undeveloped greenfield land, changes in the flood risk due to forestry felling could increase the extent of flooding and introduce new receptors to a potential flood risk, or lead to an increase in the frequency, depth and hazard where a flood risk already exists.

⁵ <https://www.gov.scot/publications/drinking-water-protected-areas-scotland-river-basin-district-maps/>.

⁶ SEPA < 2019, Significant Water Management Issues in the Scotland River Basin District.

⁷ <https://www.sepa.org.uk/environment/water/monitoring/protected-areas/>.

Catchments Sensitive to Acidification

3.1.8 Mapping of catchments vulnerable to acidification⁸ is presented by Forest Research, a research agency of the Forestry Commission. No catchments in the vicinity of the site are shown to be vulnerable to acidification.

Nitrate Sensitive Catchments

3.1.9 There are five Nitrate Vulnerable Zones (NVZs) in Scotland as set out by the Agriculture and Rural Economy Directorate⁹ and none of these are downstream of the proposed OHL. Therefore, these sensitivities have not been considered further in this assessment.

Summary

Table 3.1: Catchment Analysis and Sensitivity (North to South along OHL)			
Catchment Name	OHL Towers	Total Catchment Area (km²)	Sensitivity
River Orchy	47A to 35A	344.19km ² *	Discharges to Loch Awe Downstream Areas of Flood Risk
Allt Bhrechain	46A to 41A	N/A (Tributary of the River Orchy Catchment)	
Allt Mhaluidh	41A to 38A	N/A (Tributary of the River Orchy Catchment)	
Tealtle Water	34A to 25	17 km ²	Discharges to Loch Awe Downstream Areas of Flood Risk
Allt Eoinein	24 to 20	2.5 km ²	Discharges to Loch Awe Downstream Areas of Flood Risk
Allt Fearnna	20 to 15	4.6 km ²	Discharges to Loch Awe Downstream Areas of Flood Risk
Cladich River	14 to 4A	30.7 km ²	Discharges to Loch Awe Downstream Areas of Flood Risk Drinking Water Protected Area within a sub-catchment
Cladich DWPA (sub-catchment of the Cladich River)	8 to 4A	0.74 km ² **	Drinking Water Protected Area
River Aray	3A to 1	63.1 km ²	Discharges to Loch Fyne (coastal waterbody) at Inverary Shellfish Waters Protected Areas & Downstream Areas of Flood Risk
* Catchment extends beyond DTM data used for this assessment. Catchment Area has been derived from the Flood Estimation Handbook Web Service			
** DWPS area derived from SEPA mapping			

⁸ <https://www.forestresearch.gov.uk/tools-and-resources/fthr/catchments-vulnerable-acidification/>

⁹ <https://www.gov.scot/policies/agriculture-and-the-environment/nvz/>

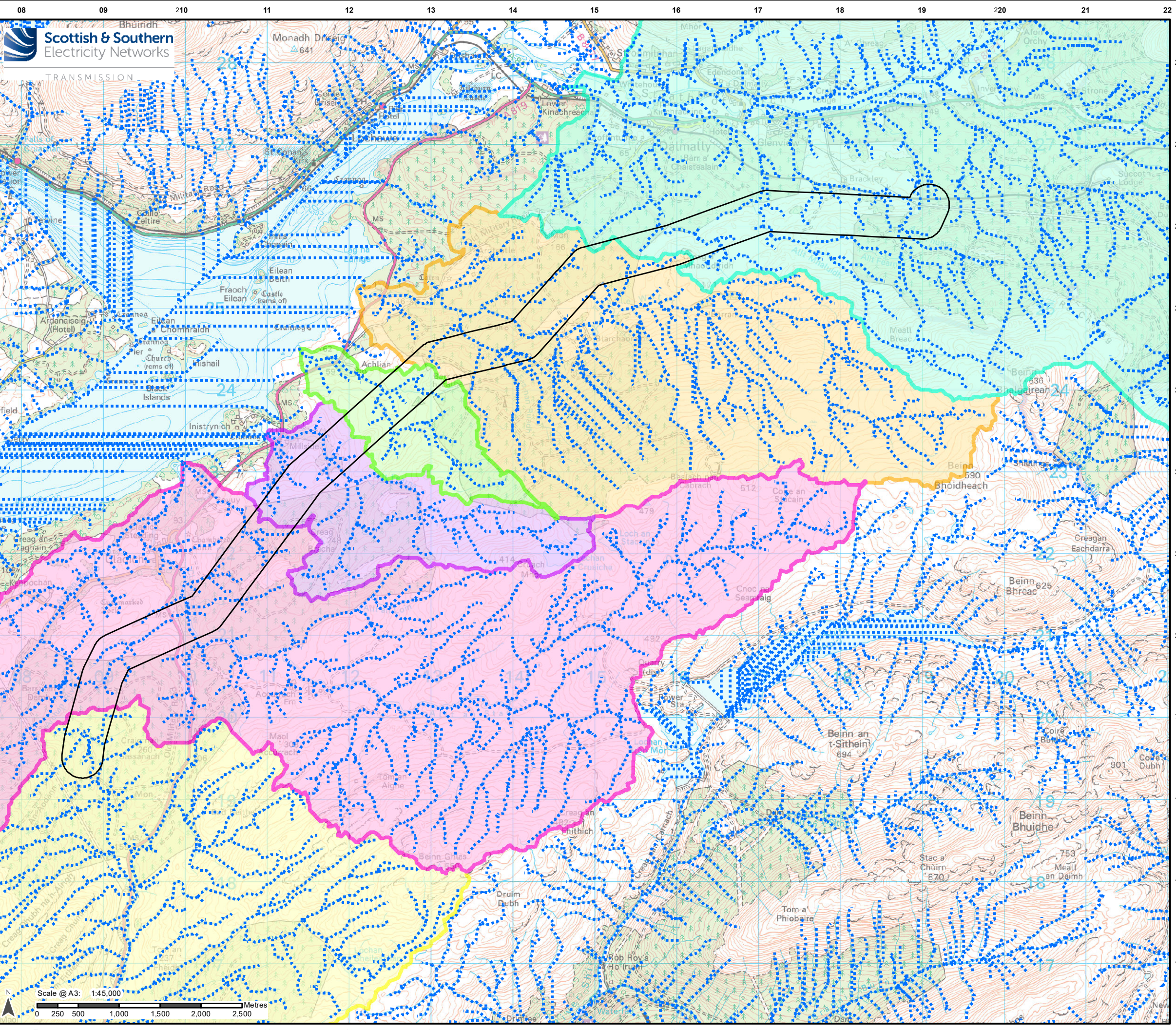
Table 3.1: Catchment Analysis					
Catchment Name	Proposed Felling Within Corridor (m²)	Proposed Management Felling Outwith Corridor (m²)	New Access Track Felling Outwith Corridor (m²)	Maximum Total Proposed Felling (ha)	Maximum Proposed Total Felling (% of total catchment)
River Orchy	143,736*	None	36,415	18.0	<1%
Tealtle Water	203,875	198,880	10,589	41.3	2.5%
Allt Eoinein	5,166	None	None	0.5	<1%
Allt Fearna	45,843	84,586	None	13.0	3%
Cladich River	187,887	683,300	14,399	88.6	3%
Cladich DWPA (sub-catchment of the Cladich River)	36,395	110,003	None	22.0	20%
River Aray	51089	183220	None	23.4	<1%
*also including felling for temporary diversion works					

4 ASSESSMENT

- 4.1.1 Analysis of the hydrological regime of the study area was carried out through the use of the ESRI ArcGIS Pro hydrological toolset and the resultant catchments areas have been assessed for regard to their sensitivity with regard to the key factors listed in the UK Forestry Standards Guidelines(UKFSG) (5th Ed):
- Public Drinking Water Supplies
 - Shellfish Waters Protected Areas
 - Catchments Sensitive to Acidification
 - Nitrate Sensitive Catchments
- 4.1.2 No catchments in the vicinity of the site are shown to be vulnerable to acidification and none of the five Nitrate Vulnerable Zones (NVZs) in Scotland are downstream of the proposed OHL. Therefore, these sensitivities have not been considered further in this assessment.
- 4.1.3 The River Aray discharges into Loch Fyne which is designated as a Shellfish Water. However, the total potential felling within this catchment (within the OHL corridor, along new access tracks and potential management felling) represents less than 1% of the overall River Aray catchment and no other catchment through which the Proposed Development would pass are shown to discharge into Loch Fyne. On this basis, it is considered that the potential felling would not impact on a Shellfish Water Protected Area.
- 4.1.4 Any catchments which exceed 3 km² in area would be expected to be associated with downstream fluvial flood risk areas. Although these flood risk areas may currently be limited to undeveloped greenfield land, changes in the flood risk due to forestry felling could increase the extent of flooding and introduce new receptors to a potential flood risk, or lead to an increase in the frequency, depth and hazard where a flood risk already exists. However, the total potential felling within these most significant catchments in flood risk terms (over 3 km² in area) would not exceed 3% of the catchment area and, therefore, it is considered that the potential felling would not impact on flood risk.
- 4.1.5 Parts of the catchment of the Cladich River with direct connectivity with the Proposed Development route are shown to be a DWPA which extends to 0.74 km² in area as derived from SEPA mapping¹⁰. The potential felling within the OHL corridor within this area extends to 0.036 km² in area. Therefore, this felling could represent approximately 5% of the DWPA and would remain below the threshold of 20% of the catchment above which felling over a 3 year period should be avoided (Guideline 34 of the UKFSG). It is noted that if the felling for the OHL corridor and the potential area of management felling was considered in conjunction, the total area could reach 20% of the DWPA. However, the management felling area represents land within which some management felling would be considered, subject to Landowner agreement and by method of Scottish Forestry felling licence approval or Long Term Forest Plan formal amendment. This additional 'management felling', outside of the OHL corridor, would be subject to a requirement for separate felling licence approval from Scottish Forestry. The final quantum and location of management felling would take account of downstream water quality in consultation with Scottish Water and felling would not be permitted without Scottish Water approval. Therefore, the total licenced clear-felling would be expected to remain below a threshold such that potential impacts on the Scottish Water outtake would be avoided.

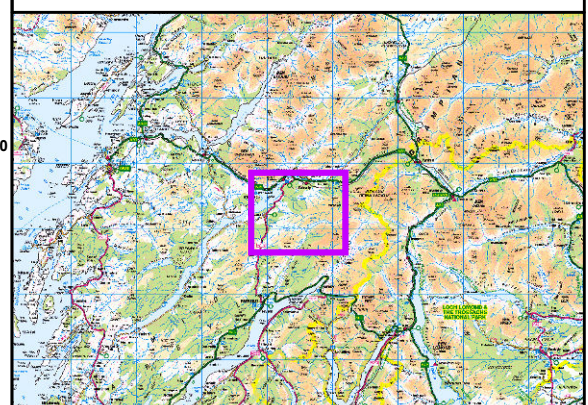
¹⁰ <https://www.gov.scot/publications/drinking-water-protected-areas-scotland-river-basin-district-maps/> (accessed May 2022)

Appendix A – Figures



Scottish & Southern
Electricity Networks

- ### Legend
- 250 m Study Area
 - Flow Pathways
 - AlltEoinein
 - AlltFearna
 - CladichRiver
 - RiverAray
 - RiverOrchy
 - TeatleWater



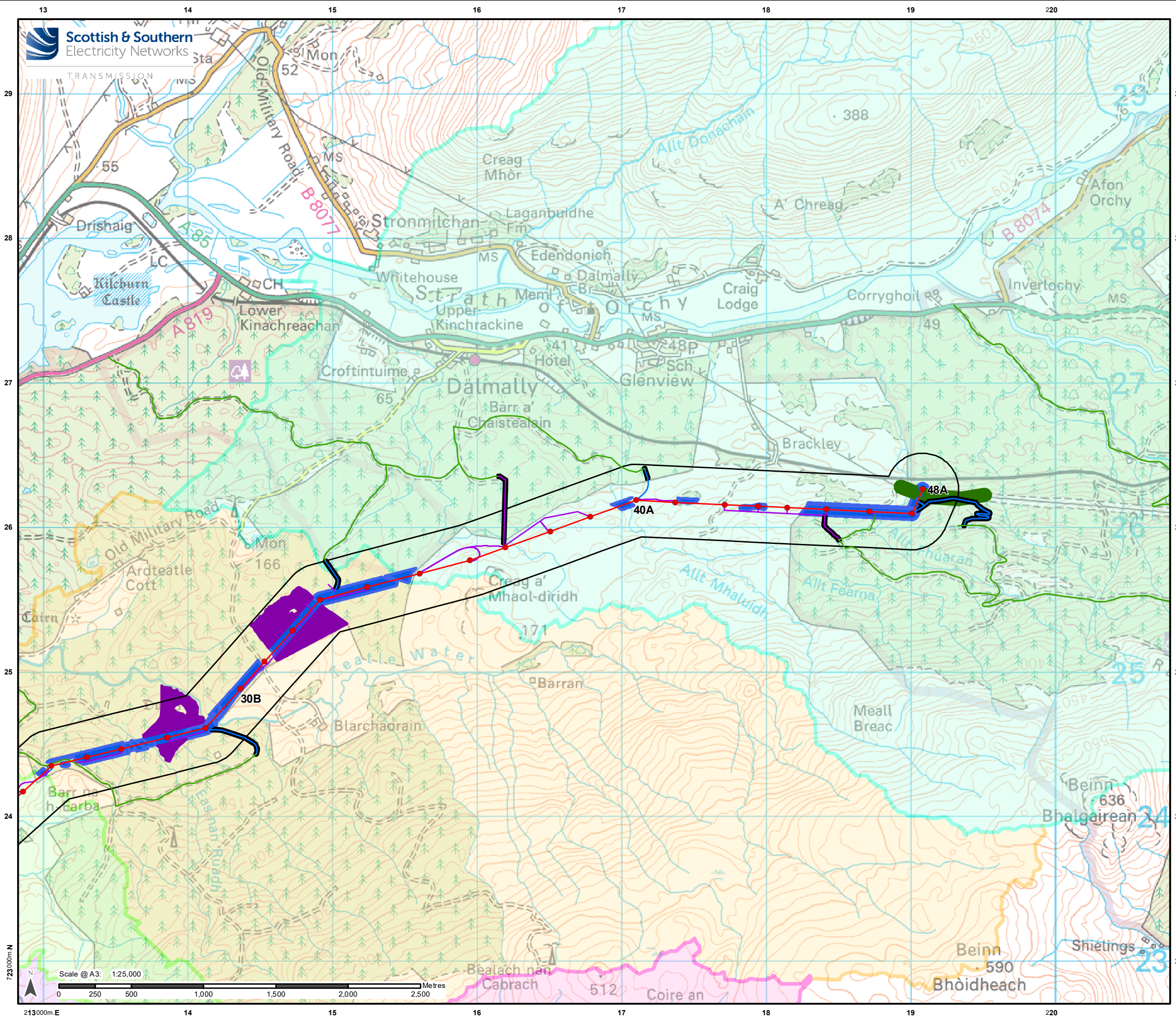
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Title:
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Figure 10.6.1:
Catchment and Flow Path Analysis

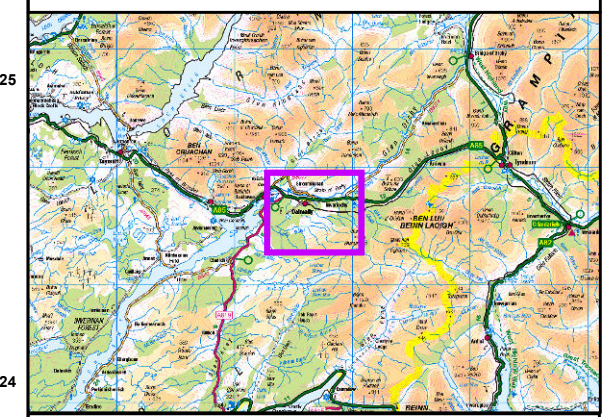
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Legend

- Corridor Felling
- New Track Felling
- Temporary Diversion Felling
- Management Felling
- Proposed OHL Towers
- Indicative Proposed Alignment
- 250 m Study Area
- Access Tracks - Existing Upgrade
- Access Tracks - New Stone Permanent
- Access Tracks - New Stone Temporary
- AlltEoinin
- AlltFearná
- CladichRiver
- RiverOrchy
- TealteWater



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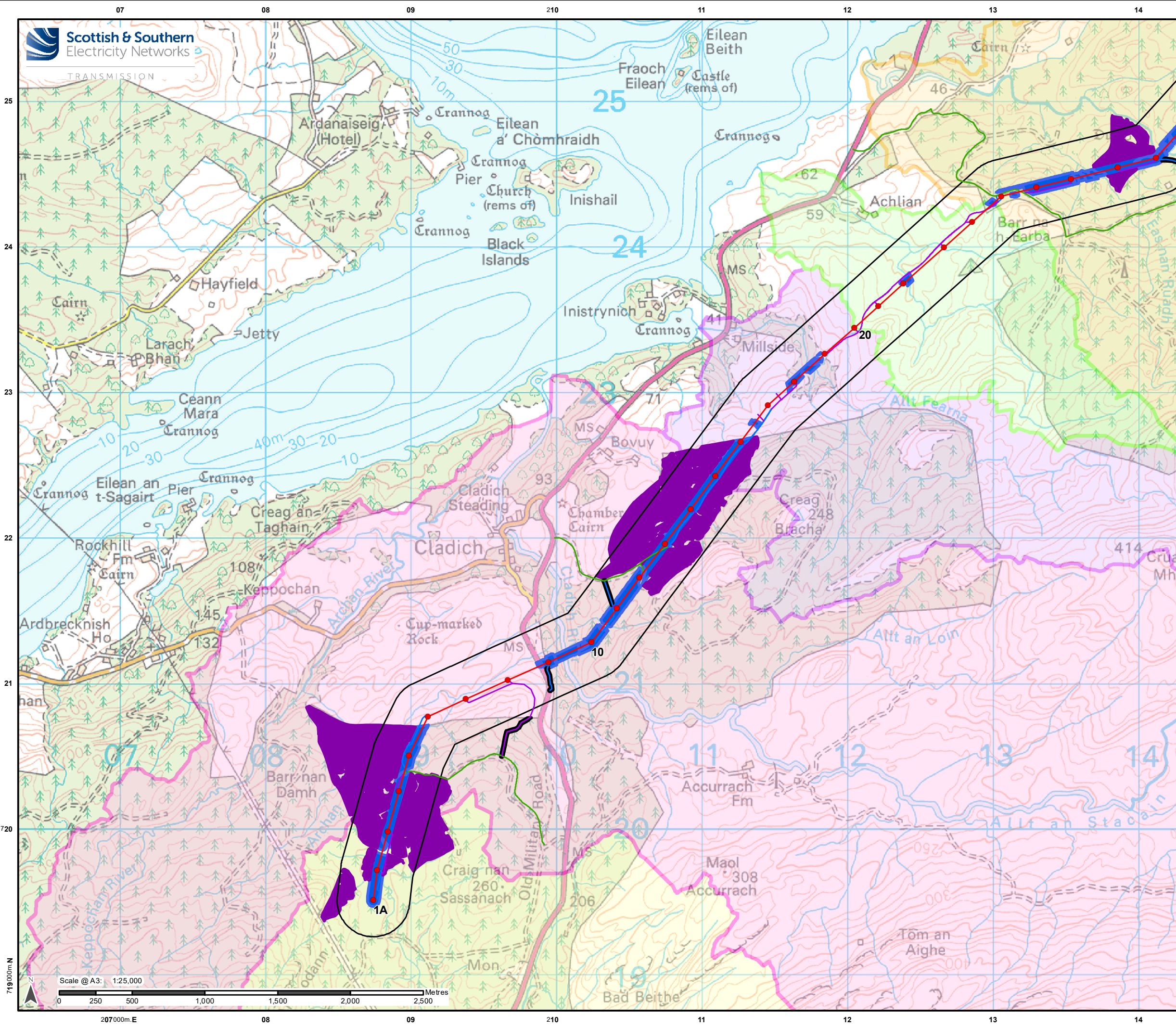
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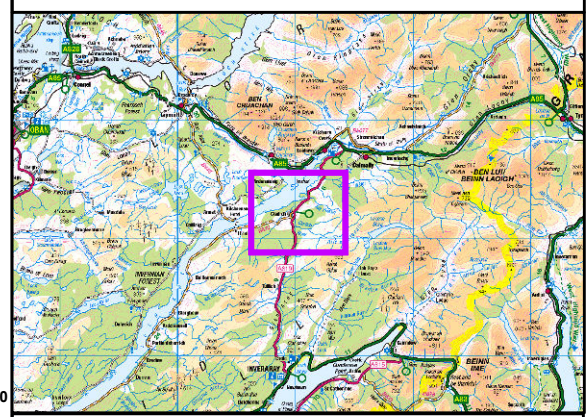
Figure 10.6.2 1/2:
Felling Areas North

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- ### Legend
- Corridor Felling
 - New Track Felling
 - Management Felling
 - Proposed OHL Towers
 - Indicative Proposed Alignment
 - 250 m Study Area
 - Access Tracks - Existing Upgrade
 - Access Tracks - New Stone Permanent
 - Access Tracks - New Stone Temporary
 - AlltEoinein
 - AlltFearna
 - CladichRiver
 - RiverAry
 - TeatleWater



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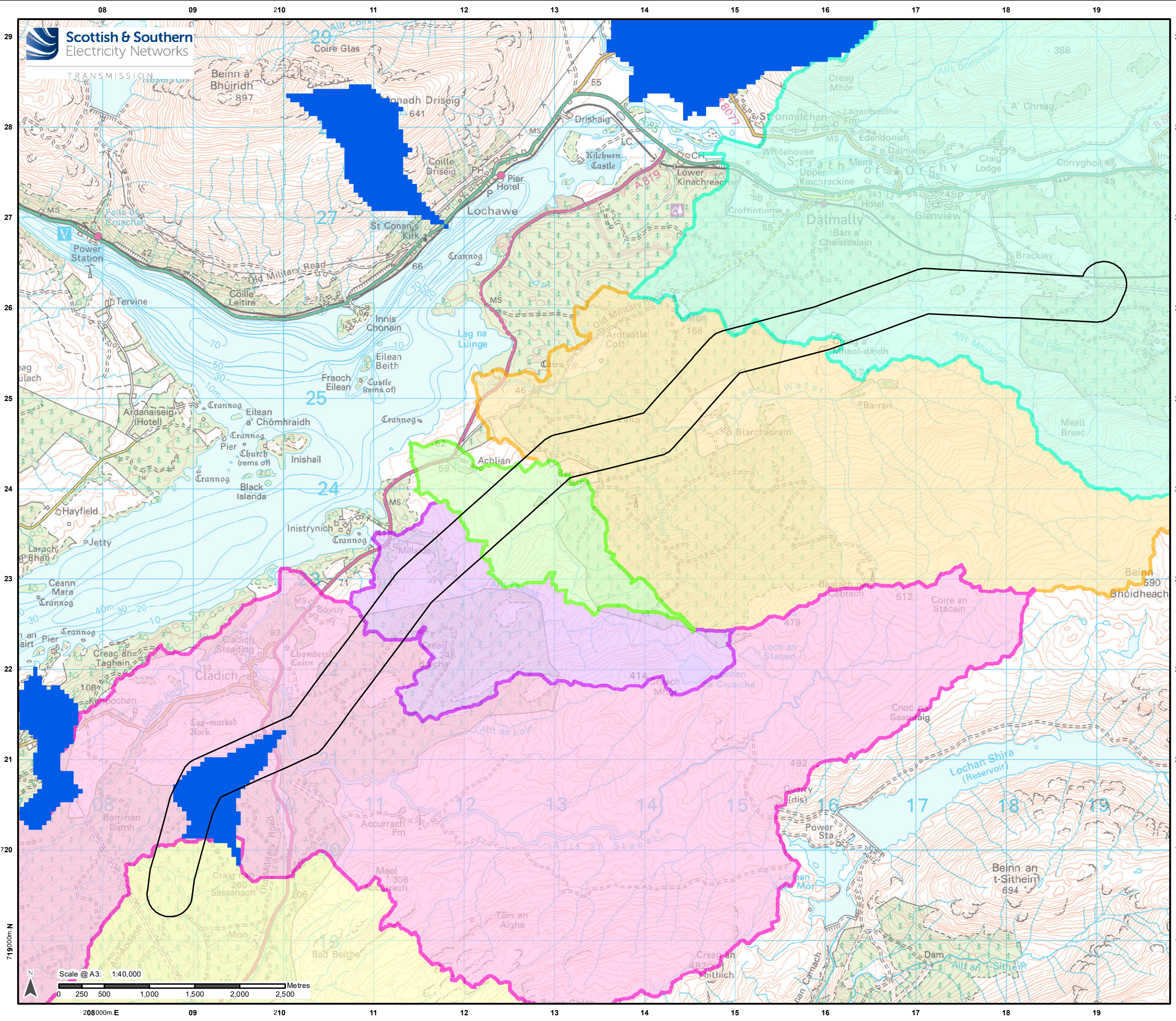
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Creag Dhubh to Dalmally 275 kV Connection

Figure 10.6.3 2/2:
Felling Areas South

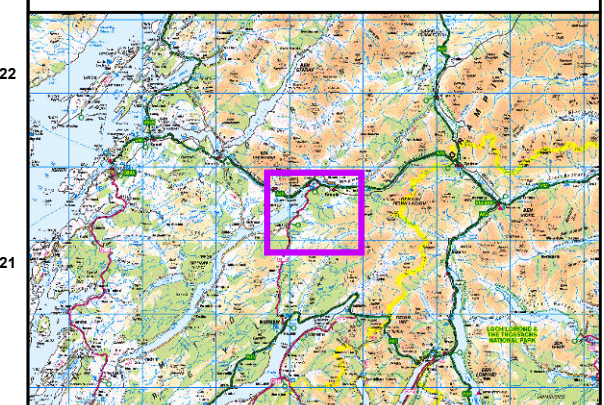
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Legend

-  250 m Study Area
-  Drinking Water Protected Areas
-  AlltEoinein
-  AlltFearna
-  CladichRiver
-  RiverAry
-  RiverOrchy
-  TealteWater



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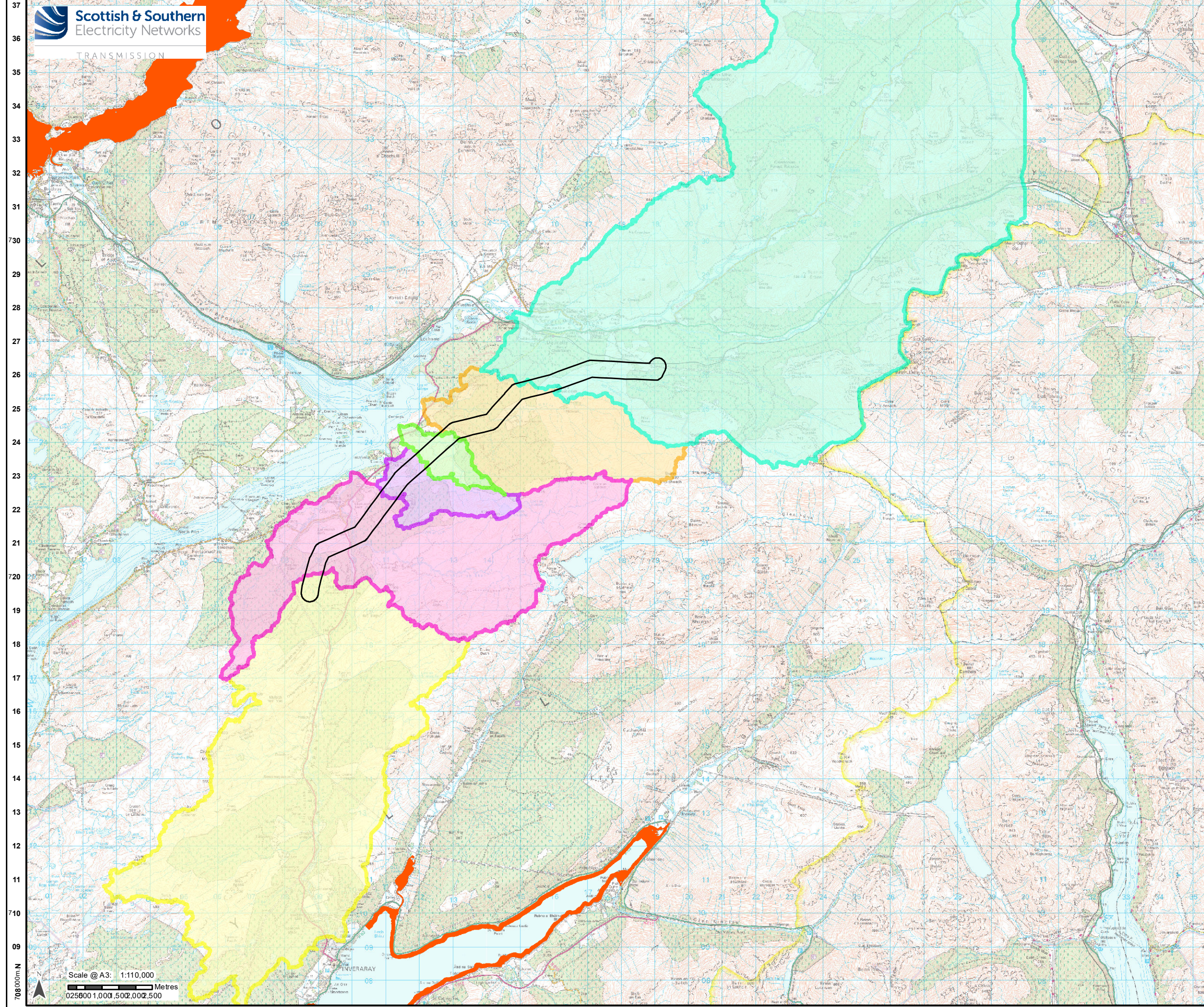
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Figure 10.6.4:
Drinking Water Protected Areas

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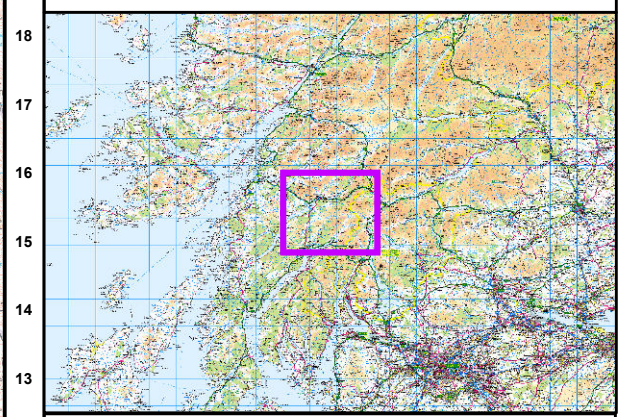
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Legend

- 250 m Study Area
- Shellfish Waters
- AlltEoinein
- AlltFearna
- CladichRiver
- RiverAray
- RiverOrchy
- TeatleWater



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Figure 10.6.5: Shellfish Waters

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