Scottish & Southern Electricity Networks

TRANSMISSION

Creag Dhubh to Dalmally 275kV Connection Environmental Impact Assessment

Volume 4 | Appendix 10.8

Groundwater Dependent Terrestrial Ecosystem (GWDTE) Assessment

April 2022

Scottish & Southern Electricity Networks
TRANSMISSION

CONTENTS

List of Abbreviations

BGS	British Geological Survey
CIEEM	Chartered Institute of Ecology and Environmental Management
EcIA	Ecological Impact Assessment
ECoW	Environmental Clerk of Works
EIA	Environmental Impact Assessment
EIA Report	Environmental Impact Assessment Report
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 (EIAR)** specifically **Chapter 10: Hydrology, Hydrogeology, Geology and Soils**, for full details of the Proposed Development and **Chapter 6: Biodiversity**.

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 The Regulations

1.2.1 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.

1.2.2 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.

1.2.3 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.

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

[1] Available online: https://ec.europa.eu/environment/water/water-framework/index_en.html [last accessed January 2022].
[2] Water Environment and Water Services (Scotland) Act 2003. https://www.legislation.gov.uk/asp/2003/3/contents [Last accessed: October 2021].
[3] The Water Environment (Controlled Activities) (Scotland) Regulations 2011, available online: https://www.legislation.gov.uk/ssi/2011/209/contents/made [last accessed January 2022].

1.3 Purpose of this Baseline Report

1.3.1 This report provides a summary of the GWDTEs that may be affected by the proposed development. It provides a description of the bedrock and superficial geology and considers National Vegetation Classification (NVC) and peat surveys that have been completed. It then presents a hydrogeological assessment of the vegetation communities identified through initial ecological surveying as potential GWDTEs, which were identified through habitat surveying that does not take in to account underlying geological conditions or connectivity to surface water contribution.

2 METHODOLOGY

2.1 Desk Study

2.1.1 The baseline hydrology and hydrogeology of the site has been characterised in **Chapter 10: Hydrology, Hydrogeology, Geology and Soils (EIAR Volume 2**) and sections relevant to the GWDTE assessment are 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 (including the field survey area of 250 m on either side of the Proposed Development and the desk study area which includes catchment areas that interact with the Proposed Development) 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. The topographic wetness index (TWI), combining local upslope contributing area and slope, was also calculated to assign a relative score indicating hydrological flow paths and probable areas of surface water accumulation. The areas of flow accumulation and the scoring of the terrain using the TWI, were used to assess the potential for connectivity of habitats to surface water flow paths.

2.2 Field Survey

2.2.1 Full results of the GWDTE field survey and the impact assessment methodology employed for ecological surveying are described in **Technical Appendix (TA) 6.1: Biodiversity Methodology and Results (EIAR Volume 4).**

2.2.2 Habitat surveys for the initial route selection process were undertaken by WSP in July 2016 and October 2017. The extended Phase 1 habitat survey was then updated by Ramboll ecologists in May 2019 and September 2020, supplemented by surveys undertaken by Lawrence Environmental in December 2020 and February 2021. NVC Vegetation Classification was carried out by WSP in September 2017 and Ramboll in May 2019 and September 2020. The surveys involved a walkover of the field survey area and a preliminary assessment of key habitats, land use and ecological features, particularly focusing on areas of natural interest that could be affected by the Proposed Development. The main habitats present were recorded using standard Phase 1 Habitat survey methodology[4].

[4] Joint Nature Conservation Committee (JNCC) (2010), Handbook for Phase 1 Habitat Survey – a Technique for Environmental Audit. Peterborough: JNCC.

2.2.3 National Vegetation Classification (NVC) surveys of the field survey area were initially completed in September 2017 by WSP to identify potential GWDTE[5] and to provide a greater level of detail than the Phase 1 habitat survey for sensitive habitats, such as peatland. The NVC surveys were updated by Ramboll concurrently with the Phase 1 habitat surveys in May 2019 and September 2020. The NVC surveys followed the methodology described in best practice guidance[6], with five x 2 m² quadrats surveyed within each habitat, and the species composition analysed. Surveys were undertaken by Ramboll ecologists alongside the Phase 1 habitat survey.

2.2.4 Methodology for the assessment of potential disruption to wetlands, and especially GWDTEs, is outlined in the Scottish Environment Protection Agency (SEPA) Land Use Planning System Guidance Note 4: Planning guidance on on-shore windfarm developments[7]. More specific guidance is provided in Guidance Note 31: Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems[8] .

2.2.5 Ecological surveying was supplemented by hydrological surveying, carried out by Ramboll in May 2021, which focused on watercourses present within the field survey area. Hydrological surveying was carried out in line with SEPA guidance (as detailed above) for the assessment of potentially sensitive receptors such as peatlands, wetlands, watercourses, lochs and water supplies, and guidance for the assessment of potentially groundwater dependent habitats. Hydrological surveying included assessment of the topography and connectivity of potential GWDTE to sources of surface water runoff, assessment of the visible emergence of groundwater and hydrological conditions across the study area to inform the assessment of GWDTE habitats.

2.3 Methodology for Assessment of GWDTE Sensitivity

2.3.1 Culshaw and Halcro-Johnston (2013) set out a methodology for assessment of potential GWDTE areas by which hydrogeomorphic classification is used to identify the degree of dependence that the wetland ecosystem is likely to have to groundwater. 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 11.3.1**), which provides an identification of sensitive and potentially sensitive GWDTEs to ascertain the significance of the risks from the Proposed Development.

Table 3.3.1: Matrix for Identification of Sensitive GWDTEs from Ecological and Hydrogeological Assessments

Ecological and Hydrological Assessment of NVC Communities	Hydrogeological Assessment Groundwater Dependency Level		
	High Likelihood	Moderate Likelihood	Low Likelihood
Highly groundwater dependent	Sensitive GWDTE	Potentially sensitive GWDTE	Potentially sensitive GWDTE
Moderately groundwater dependent	Potentially sensitive GWDTE	Potentially sensitive GWDTE	Not sensitive
Not groundwater dependent	Potentially sensitive GWDTE	Not sensitive	Not sensitive

[5] Guidance on Assessing the Impacts of Wind farm Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems: https://www.sepa.org.uk/media/143868/lupsgu31_planning_guidance_on_groundwater_abstractions.pdf [1 April 2020].
[6] Rodwell, J.S. (2006), National Vegetation Classification: User's Handbook. Peterborough: JNCC.
[7] SEPA, 2017. Land Use Planning System Guidance Note 4: Planning advice on windfarm developments.
[8] SEPA, 2017. Land Use Planning System Guidance Note 31: Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems

2.3.2 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".

2.3.3 SNIFFER (2007) guidance[9] 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 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.

2.4 Limitations and Assumptions

2.4.1 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.

2.4.2 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 definitely be confirmed by a lack of field signs and only concludes that an indication of its presence was not located during the survey effort.

2.4.3 Hydrological surveying provided assessment of surface water features within the study area (at accessible locations) and indicative review of hydrological conditions across the study area, surveying did not include site-specific assessment of potential GWDTE areas.

[9] SNIFFER (2007) WFD66 – Wetland Hydrogeomorphic Classification for Scotland. Edinburgh: SNIFFER. Helen Culshaw and Andrew Halcro-Johnston, Golder Associates (UK) Ltd, "An integrated hydro-ecological approach to the identification of sensitive groundwater dependent terrestrial ecosystems within wind farm Environmental Impact Assessment" [Available at: https://www.geolsoc.org.uk/~/media/shared/documents/specialist%20and%20regional%20groups/Hydro/GDE/Posters/Poster4_GDE_Meeting_Feb13.pdf?la=en [accessed 21/03/2016].

3 RESULTS

3.1 Desk Study

Geology

3.1.1 The 1:625,000 and 1:50,000 scale geological mapping available from the British Geological Survey[10] (BGS) (**TA Figures 10.8.1** and **10.8.2**) shows most of the site to be underlain by Diamicton Till, with small areas of peat or absent of superficial geology. These are underlain by psammite, semipelite and pelites of the Argyll Group, interspersed with areas of unnamed igneous intrusions.

3.1.2 NatureScot carbon rich soils, deep peat and priority habitat mapping[11] shows the area between T33 and Glen Lochy (Succoth Glen) as predominantly 'Class 5' soils, particularly in areas covered by commercial plantation, which are defined as mineral or peat soils with no peatland vegetation[11]. Large areas of 'Class 2' and 'Class 3' soils are present in the open areas around Creag a'Mhaol-diridh which are not dominated by commercial plantation. Class 2 soils are of national importance and are defined as peat soils with high potential to be restored to peatland. Class 3 soils are those on which the dominant vegetation cover is not priority peatland habitat (although occasional peatland habitats can be found) but is associated with wet and acidic conditions and most soils are carbon-rich with some areas of deep peat. Further areas of Class 2 and 3 soils extend across open areas to the south of Achlian and on open land to the south of Cladich.

Hydrogeology

3.1.3 According to BGS 1:625,000 scale hydrogeological mapping (**Figure 10.8.3**), the OHL route overlies aquifers assessed to be of Low Productivity, within which small amounts of groundwater may be present the near surface weathered zone and fractures.

Surface Water Baseline

3.1.4 Baseline assessment of topographic controls on the distribution of surface water runoff across the study area was carried out (**Figure 10.8.4**), showing waterbodies and watercourses, flow accumulation paths and mapping of TWI. This provides the likely relative contribution of surface water in supporting habitats that have been identified as potentially groundwater dependent.

3.1.5 Findings of the topographic assessment were compared with each area on which potentially groundwater dependent vegetation communities were identified through NVC ecological surveying recorded in **Figure 10.8.5**.

[10] BGS, GeoIndex Onshore. Available Online: https://www.bgs.ac.uk/.

[11] National Soil Map of Scotland, Carbon and peatland 2016 map. Available online: https://soils.environment.gov.scot/maps/soil-maps/national-soil-map-of-scotland/ [Last accessed January 2022].

3.2 Field Survey

NVC Surveying

3.2.1 A number of potential High and Moderate[12] GWDTE areas were identified as part of the NVC surveys. All potentially groundwater dependent habitats within the field survey area are recorded in **Figure 10.8.5** .

3.2.2 Where a mosaic of NVC classifications was observed, only the community occupying the largest proportion of the mosaic has been considered as representative of the potential for the mosaic to be a GWDTE. **Figure 10.8.5** indicates the primary NVC community within each mosaic and indicates the potential for the identified NVC communities to be a GWDTE. NVC surveying does not take in to account underlying hydrogeological conditions or the hydrological context of each potentially groundwater dependent area.

3.2.3 Details of vegetation communities and the composition of habitat mosaics identified are provided in **Chapter 6: Biodiversity (EIAR, Volume 2**).

3.3 Groundwater Dependency

3.3.1 **Table 3.3.2** sets out the NVC communities[12] encountered across the site and provides the Initial Potential NVC GWDTE Classification, subject to local factors such as ecological and hydrological conditions, which have been assessed further. The full names of NVC habitat types are provided in **Technical Appendix 6.1: Biodiversity Methodology and Results**. **Table 3.3.2** assesses the likely degree of dependency on the underlying groundwater body, according to the site-specific ecological and hydrological conditions (findings are also presented in **Figure 10.8.6**). For each area assessed, further detail of the assessment of potential groundwater dependency is provided based on the site specific hydrological conditions and an overall Assessment of Groundwater Dependency is provided.

3.3.2 This assessment includes 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 soils and permeability of upgradient geology;
- Topography and the presence of rills or runnels indicative of surface runoff (quantified through mapping of areas of elevated topographic wetness and likely paths of flow accumulation, delineated through the assessment of OS DTM data);
- The presence of indicative 'flush' patterns of vegetation communities;
- Land use; and,
- The relative proportion of NVC communities and the potential dominance of non-GWDTE communities within surveyed areas.

3.3.3 The overall assessment of Groundwater Dependency demonstrates that most areas identified as potential GWDTE habitats are surface water and not groundwater dependent. A total of two locations, were recorded (Locations 97 and 100, ref figure) that are of moderate groundwater dependency. Refer to **Table 3.3.2** and explanatory text below.

[12] As defined by Land Use Planning System SEPA Guidance Note 31 (Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems). These categories are based on the UKTAG list of NVC communities and associated groundwater dependency scores (2008).

Table 3.3.2: Initial Potential GWDTE Classification (Based on NVC Data Only) and Assessed Groundwater Dependency (Informed by Hydrological Assessment)

Location ID	NVC Code	Initial Potential NVC GWDTE Classification	Hydrological Assessment	Assessment of Groundwater Dependency
1	M15/M19*	Moderate	Area of surface water accumulation and elevated TWI	Low
2	M17/M6	High	Existing forest break, area of surface water accumulation	Low
3	MG10	Moderate	Intersected by surface water flow paths, elevated TWI	Low
4	M17/M15	Moderate	Intersected by surface water flow paths, elevated TWI	Low
5	M25/M23	Moderate/High	Elevated TWI - area of surface water accumulation	Low
6	U20/M23/U4/U6	Moderate/High	Elevated TWI - area of surface water accumulation, forest break	Low
7	M25/M23	Moderate/High	Area of surface water accumulation, in connection to surface water flow paths	Low
8	M15/U4/U5	Moderate	Moderate area defined by land use, likely ombrogenous mire	Low
9	M25/M27/M6d	Moderate/High	Upslope area, unlikely flush, part of larger moderate area defined by land use	Low
10	U4/MG10	Moderate	Moderate area defined by land use, likely ombrogenous mire	Low
11	M15/U6	Moderate	Moderate area defined by land use, likely ombrogenous mire	Low
12	M23a	High	Likely ombrogenous (ridge), in connection to mosaic of moderate communities	Low
13	M23/M6	High	Direct connection to surface water feature	Low
14	M15/U6	Moderate	Aerial imagery suggests surface water flow path from east	Moderate
15	U6	Moderate	Adjacent to watercourse, connection to surface water flow path	Low
16	MG10	Moderate	Adjacent to watercourse, connection to surface water flow path	Low

Table 3.3.2: Initial Potential GWDTE Classification (Based on NVC Data Only) and Assessed Groundwater Dependency (Informed by Hydrological Assessment)				
17	M23a	High	Area of surface water accumulation, surface water flow path from east	Low
18	MG10/U6	Moderate	Area characterised by network of surface water flow paths, marginal area of surface water accumulation	Low
19	U6	Moderate	Area characterised by network of surface water flow paths, marginal area of surface water accumulation	Low
20	MG10	Moderate	Area characterised by network of surface water flow paths, marginal area of surface water accumulation	Low
21	MG10/U20	Moderate	Area characterised by network of surface water flow paths, marginal area of surface water accumulation	Low
22	M28	Moderate	Area characterised by network of surface water flow paths, marginal area of surface water accumulation	Low
23	M23a	High	Area of surface water accumulation, TWI), surface water flow paths from south east	Low
24	M25a	Moderate	Intersected by watercourse and surface water flow paths	Low
25	M25/U6	Moderate	Intersected by watercourse and surface water flow paths	Low
26	M25a/M6	Moderate/High	Moderate area defined by land use, likely ombrogenous mire	Low
27	M25a	Moderate	Intersected by watercourse and surface water flow paths	Low
28	M6	High	Confluence of surface water features, high TWI	Low
29	M25a	Moderate	Habitat mosaic is supported by surface water flow paths and areas of elevated TWI	Low
30	M15/U6	Moderate	Habitat mosaic is supported by surface water flow paths and areas of elevated TWI	Low
31	M15/U6	Moderate	Habitat mosaic is supported by surface water flow paths and areas of elevated TWI	Low

Table 3.3.2: Initial Potential GWDTE Classification (Based on NVC Data Only) and Assessed Groundwater Dependency (Informed by Hydrological Assessment)				
32	M15/U6	Moderate	Habitat mosaic is supported by surface water flow paths and areas of elevated TWI	Low
33	M6	High	On flow path from area of surface water accumulation to south west	Low
34	M15/U6	Moderate	Habitat mosaic is supported by surface water flow paths and areas of elevated TWI	Low
35	M15/U6	Moderate	Habitat mosaic is supported by surface water flow paths and areas of elevated TWI	Low
36	M15/U6	Moderate	Habitat mosaic is supported by surface water flow paths and areas of elevated TWI	Low
37	M15/U6	Moderate	Habitat mosaic is supported by surface water flow paths and areas of elevated TWI	Low
38	U4/U6/U20	Moderate	Habitat mosaic is supported by surface water flow paths and areas of elevated TWI	Low
39	M15/U6	Moderate	Habitat mosaic is supported by surface water flow paths and areas of elevated TWI	Low
40	M25	Moderate	Habitat mosaic is supported by surface water flow paths and areas of elevated TWI	Low
41	M25a	Moderate	Habitat mosaic is supported by surface water flow paths and areas of elevated TWI	Low
42	M15/M17	Moderate	Habitat mosaic is supported by surface water flow paths and areas of elevated TWI	Low
43	W7	High	Surface water flow path from south east, TWI accumulation	Low
44	M15	Moderate	Habitat mosaic is supported by surface water flow paths and areas of elevated TWI	Low
45	W7/W4	High	Direct connection to surface water features and surface water flow paths	Low
46	W4	High	Surface water feature from SE, surface water accumulation from south	Low

Table 3.3.2: Initial Potential GWDTE Classification (Based on NVC Data Only) and Assessed Groundwater Dependency (Informed by Hydrological Assessment)				
47	M15	Moderate	Habitat mosaic is supported by surface water flow paths and areas of elevated TWI, rain fed	Low
48	M23	High	Plateau on ridge, unlikely point of emergence, likely soligenous wet heath	Low
49	W4	High	surface water accumulation in north and adjacent to surface water, area of elevated TWI	Low
50	M15/M19	Moderate	Habitat mosaic is supported by surface water flow paths and areas of elevated TWI, rain fed	Low
51	M15/M6/U20	Moderate/High	Upslope connection to flow accumulation path	Low
52	M23	High	Very small area in connection to moderate mosaic, rain fed	Low
53	M6d	High	Direct connection to surface water features and surface water flow paths	Low
54	M25	Moderate	Habitat mosaic is supported by surface water flow paths and areas of elevated TWI	Low
55	M15/U20	Moderate	Habitat mosaic is supported by surface water flow paths and areas of elevated TWI	Low
56	M25/M23	Moderate/High	Area of surface water accumulation paths from west and south, stream headwaters	Low
57	MG10	Moderate	Habitat mosaic is supported by surface water flow paths and areas of elevated TWI	Low
58	M15/U20	Moderate	Habitat mosaic is supported by surface water flow paths and areas of elevated TWI	Low
59	U4/U6/MG10	Moderate	Habitat mosaic is supported by surface water flow paths and areas of elevated TWI	Low
60	M15	Moderate	Habitat mosaic is supported by surface water flow paths and areas of elevated TWI	Low
61	U20/M6	High	In connection to flow accumulation path, areas of high TWI in east, def by land use	Low
62	M25/M6d	Moderate/High	Area of flow accumulation path, high TWI	Low

Table 3.3.2: Initial Potential GWDTE Classification (Based on NVC Data Only) and Assessed Groundwater Dependency (Informed by Hydrological Assessment)				
63	M25a/M23a/M6d	Moderate/High	Intersected by several flow accumulation paths, areas of high TWI	Low
64	W7	High	Area of surface water flow accumulation	Low
65	W7	High	Area of surface water flow accumulation	Low
66	W7	High	Area of surface water flow accumulation (from upslope forestry)	Low
67	W7	High	Area of surface water flow accumulation (from upslope forestry)	Low
68	M25a/M15	Moderate	Habitat mosaic is supported by surface water flow paths and areas of elevated TWI	Low
69	W7/W17*	High	Connection to watercourse, surface water of flow accumulation, areas of high TWI	Low
70	W4b*	High	Connection to watercourse, surface water of flow accumulation, areas of high TWI	Low
71	M23a	High	Connection to surface water flow path, high TWI	Low
72	M23a	High	Linear feature in connection to watercourse	Low
73	M25	Moderate	Habitat mosaic is supported by surface water flow paths and areas of elevated TWI	Low
74	M15	Moderate	Habitat mosaic is supported by surface water flow paths and areas of elevated TWI	Low
75	M25/U20	Moderate	Habitat mosaic is supported by surface water flow paths and areas of elevated TWI	Low
76	M23a	High	Likely ombrogenous (ridge), in connection to mosaic of moderate communities	Low
77	M15	Moderate	Upslope area of rain fed mire, ombrogenous	Low
78	M23a	High	Bisected by watercourse, area of surface water accumulation, high TWI	Low

Table 3.3.2: Initial Potential GWDTE Classification (Based on NVC Data Only) and Assessed Groundwater Dependency (Informed by Hydrological Assessment)				
79	M25	Moderate	Habitat mosaic is supported by surface water flow paths and areas of elevated TWI	Low
80	W17/W4/W11	High	Bisected by watercourse, area of surface water accumulation, High TWI	Low
81	W11/W4/W17/W7	High	Floodplain, area of surface water accumulation, high TWI	Low
82	W7/W11/W17/W4	High	Linear feature in connection to watercourse and surface water flow paths	Low
83	M6d	High	Connection to surface water flow path, elevated TWI	Low
84	M6d	High	Connection to surface water flow path	Low
85	M6d	High	Area of surface water accumulation (flow paths and ponding), high TWI	Low
86	M6d	High	Area of surface water accumulation (flow paths and ponding), high TWI	Low
87	M6d	High	Connection to upslope flow paths, elevated TWI	Low
88	M6d	High	Connection to upslope flow paths, elevated TWI	Low
89	M6d	High	Connection to upslope flow paths, elevated TWI	Low
90	M6d	High	Marginal area of surface water accumulation (margin of M21b community), 12 m to watercourse	Low
91	M6d	High	Surface water accumulation flow path, elevated TWI	Low
92	M6d	High	Flow accumulation, elevated TWI	Low
93	M6d	High	Elevated TWI, adjacent to watercourse	Low
94	M6d	High	Ridgeline, unlikely supported by the emergence of GW, geometry low probability of flush	Low
95	M6d	High	Field margin, Connection to surface water flow path, adjacent to watercourse	Low

Table 3.3.2: Initial Potential GWDTE Classification (Based on NVC Data Only) and Assessed Groundwater Dependency (Informed by Hydrological Assessment)				
96	M6d	High	Extended area rain fed mire (numerous surface water flow paths)	Low
97	M6d	High	Marginal area of surface water accumulation, lower ground in proximity to watercourse (20 m)	Moderate
98	M6d	High	Extended area rain fed mire (numerous surface water flow paths)	Low
99	M6d	High	In connection to wider area of surface water accumulation, marginal area of open land	Low
100	M6d	High	Connection to surface water flow paths, areas of elevated TWI	Moderate
101	M6d	High	Connection to surface water flow paths, elevated TWI	Low
102	M6d	High	Connection to upslope flow paths and areas of surface water accumulation	Low
103	M6d	High	Part of network of habitat comprising rain fed mire	Low
104	M6d	High	Connection to upslope flow paths and areas of surface water accumulation	Low
105	M21b	High	Connection to surface water flow paths, areas of elevated TWI	Low
106	M21b	High	Rain fed mire (numerous surface water flow paths)	Low
107	M21b	High	Rain fed mire (numerous surface water flow paths)	Low
108	M6d	High	Existing forest break, surface water flow path, high TWI	Low
109	M6d	High	Existing forest break, surface water flow path, high TWI	Low

3.3.4 The Assessment of Groundwater Dependency (**Table 3.3.1)**, which takes in to account hydrogeological and hydrological setting, finds that the majority of potential GWDTE are assessed as 'Low'. The potential GWDTE's are located where groundwater is unlikely to represent the primary source of water supply. At these locations, the accumulation of surface water from watercourses, smaller or ephemeral surface water flow paths (as defined from site topography) and the distribution of likely topographic wetness are such that surface water is considered to support the vegetation communities present.

3.3.5 The greatest extent of habitat with potential to be groundwater dependent, identified through NVC surveying, is found between towers 47a and 34a and is dominated by modified bog (Figure 10.6.5)[13]. However, the potential GWDTEs (M6d, M23 and M15/M19 vegetation communities) are intersected by several watercourses and a dense network of surface water flow paths, which is consistent with the assessment in **Table 3.3.2** of a higher probability of surface water dependency. Furthermore, the geometry of surveyed habitats is not consistent with the presence of flushes or localised emergence of groundwater in that they are distributed areas of adjoining habitat mosaic, and not localised or linear springs.

3.3.6 Further habitats, initially identified with a potential to be groundwater dependent through NVC surveying, are predominantly in connection to watercourses (which flow generally from south to north across the study area) or smaller surface water flow paths that connect to these watercourses.

3.3.7 Potential GWDTE were considered present to the south of Achlian and to the south of Cladich on unforested land, characterised by Class 2 and 3 peatland soils[13]. The areas on which the initial ecological NVC GWDTE classification was recorded to be moderate or high are found predominantly on semi-improved acid grassland to the south of Achlian. This area is characterised by surface water accumulation and the distribution of habitats is not indicative of flushes or localised emergence of groundwater.

Sensitivity Assessment

3.3.8 The underlying bedrock aquifer is assessed by the BGS to be of Low productivity (within which storage or flow of groundwater is likely to be limited) and where drift deposits (Till, Diamicton) are present within the site, these are also likely to be of low productivity. Therefore, it is assumed that there is low likelihood of groundwater dependency for all the GWDTEs within the site, based on assessment of underlying hydrogeology.

3.3.9 Based on the cross reference of site-specific ecological and hydrological assessment with underlying hydrogeological conditions (**Table 3.3.1**), potential GWDTEs are considered 'not sensitive' to alterations in groundwater supply, in the context of the Proposed Development. The underlying bedrock aquifer is unlikely to provide sufficient groundwater to support GWDTEs therefore, habitats are considered to rely on surface water and are unlikely to be sensitive to changes in groundwater supply in the context of the Proposed Development.

[13] National Soil Map of Scotland, Carbon and peatland 2016 map. Available online: https://soils.environment.gov.scot/maps/soil-maps/national-soil-map-of-scotland/ [Last accessed January 2022].

4 MITIGATION MEASURES AND RECOMMENDATIONS

Mitigation

4.1.1 No mitigation to prevent adverse effects on the quality or quantity of groundwater supplies is considered necessary as the potential GWDTE areas assessed are not considered groundwater dependent. While the initial ecological NVC classification[14] of these habitats found a number of vegetation communities to be of High and Moderate groundwater dependency, potential GWDTE sites were shown by hydrological and hydrogeological assessment to be linked to bog and mire habitats which are reliant on surface water supplies.

4.1.2 Direct habitat loss of areas identified as connected to peat bog and mire habitats will result from the proposed development and such habitats are sensitive to any alterations in hydrological connectivity. Assessment of direct habitat loss that would occur as a result of the Proposed Development is detailed in **Chapter 6: Biodiversity (EIAR Volume 2).** Mitigation is presented in **TA 6.3: Outline Habitat Management Plan and the TA 10.2 Outline Peat Management Plan (EIAR Volume 4)** that includes habitat restoration proposals and provides measures during construction to protect habitats.

Recommendations

4.1.3 The locations assessed in **Table 3.3.2** are connected to peat bog and mire habitats (**Figures 6.2, 6.3, EIAR Volume 3a**), and are underlain by Class 2 and 3 peat soils. Mitigation measures for peat and mire habitats are provided in **Chapter 6: Biodiversity (EIAR Volume 2), TA 6.3: Outline Habitat Management Plan and the TA 10.2 Outline Peat Management Plan (EIAR Volume 4)**

4.1.4 Measures to ensure the continued supply of surface waters to rain-fed habitats or areas of surface water accumulation are also detailed in **Chapter 10: Hydrology, Hydrogeology and Geology, the outline CEMP provided in Technical Appendix 2.2: Outline CEMP, applicable SSEN General Environmental Management Plans (GEMPs).**

4.1.5 Key measures that relate to the protection of habitats sensitive to alterations in surface water would be implemented as follows:

- The appointed contractor would provide a CEMP (in line with **TA 2.2: Outline CEMP, EIAR Volume 4**) containing details of drainage measures that will maintain hydrological connectivity and ensure water quality is protected in peatland and wetland habitats
- The appointed contractor to follow relevant SSEN GEMPs and SEPA best practice guidance[15] , and produce PPPs prior to works.
- Details of SuDS would be included in the DIA and the final CEMP, as required, to provide a surface water management and treatment train that would mitigate potential adverse impacts on the hydrology of the site and surrounding areas during the construction phase of the Proposed Development

[14] Guidance on Assessing the Impacts of Wind farm Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems: https://www.sepa.org.uk/media/143868/lupsgu31_planning_guidance_on_groundwater_abstractions.pdf [1 April 2020].
[15] SEPA Guidance. Available online: https://www.sepa.org.uk/regulations/water/guidance/.

Appendix A – Figures

Figure 10.8.1

Figure 10.8.2

Figure 10.8.3

Figure 10.8.4

Figure 10.8.5

Figure 10.8.6