CALEDONIA
Offshore Wind Farm

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Volume 7E Proposed Development (Onshore) Appendices

Appendix 6-2 Groundwater-Dependent Terrestrial Ecosystems Assessment

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Acronyms and Abbreviations

CAR	Controlled Activities Regulations
CEMP	Construction Environmental Management Plan
ECoW	Ecological Clerks of Work
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
GPP	Guidance on Pollution Prevention
GWDTEs	Groundwater-Dependent Terrestrial Ecosystems
NVC	National Vegetation Classification
OnTI	Onshore Transmission Infrastructure
ONEC	Onshore Export Cable Corridor
SEPA	Scottish Environment Protection Agency
UK	United Kingdom
UKTAG	UK Technical Advisory Group
WEWS	Water Environment and Water Services
WFD	Water Framework Directive

1 Introduction

1.1.1.1 This technical appendix supports Volume 5, Chapter 6: Hydrology and Hydrogeology of the Environmental Impact Assessment Report (EIAR).

1.1.1.2 This technical appendix describes the potentially Groundwater-Dependent Terrestrial Ecosystems (GWDTEs) identified within the Onshore Transmission Infrastructure Red Line Boundary (OnTI RLB) and the assessment study area. It also identifies and assesses the potential impact on these habitats resulting from the construction, operation and decommissioning of the Proposed Development (Onshore). A description of the Proposed Development (Onshore), outlining what components are included within the OnTI is presented in Volume 1, Chapter 4: Proposed Development Description (Onshore).

1.1.1.3 The appendix provides a description of the National Vegetation Classification (NVC) communities identified through habitat surveys in the south of the study area and where it was considered habitats had the potential to provide the right conditions to support potential GWDTEs. No other areas of the OnTI were highlighted as having potential to support GWDTEs during the Phase 1 habitat surveys. The methodology and justification for the NVC surveys is provided in Volume 5, Chapter 3: Terrestrial Ecology and Biodiversity.

1.1.1.4 The appendix also outlines the context of local geology, peat, soils and hydrology with information obtained from the habitats, peat and GWDTE survey detailed within Volume 7E, Appendix 7-2: Peat Survey Reports.

1.2 Regulatory background

1.2.1.1 GWDTEs are protected under the Water Framework Directive (WFD) (European Parliament, 2003[1]) and are potentially sensitive receptors to the impacts of development.

1.2.1.2 The 2000/60/EC WFD is transposed into Scottish law by the Water Environment and Water Services (Scotland) Act (WEWS Act) 2003 (Scottish Parliament, 2003[2]) and is the principal legislation regarding the water environment. The WFD aims to protect and enhance the quality of surface freshwater (including lakes, rivers, and streams), groundwater, GWDTEs, estuaries and coastal waters.

1.2.1.3 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.

1.2.1.4 The WEWS Act gives Scottish Ministers powers to introduce regulatory controls over water activities to protect, improve and promote sustainable use of Scotland's water environment.

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

1.2.1.6 Scottish Environment Protection Agency (SEPA) Guidance Note 31 (SEPA, 2017[4]) sets out the requirements for GWDTE consideration within planning applications. Consideration is required for sensitive habitats that lie within 100m of areas likely to be excavated to less than 1 metre (m) in depth, or within 250m of excavations deeper than 1m.

2 Methodology

2.1 Study area

2.1.1.1 The study area for this assessment reflects the Phase 1 habitat survey study area, which is detailed further in Volume 5, Chapter 3: Terrestrial Ecology and Biodiversity.

2.1.1.2 During the identification process of statutory and non-statutory designated sites that could potentially support GWDTEs, the study area was expanded to 1 kilometre (km) from the OnTI RLB. However, as no designated sites were found within this area, designated sites are not discussed further within this assessment.

2.2 Baseline characterisation and receptor identification

2.2.1 Desk study

2.2.1.1 The baseline hydrology and hydrogeology of the study area has been characterised in Volume 5, Chapter 6: Hydrology and Hydrogeology, and sections relevant to the GWDTE assessment are summarised in this document.

2.2.1.2 The desk study undertaken used a review of available relevant information sources on the baseline conditions within the study area. Information sources include:

- Ordnance Survey mapping (Ordnance Survey, 2022[5]);
- High-resolution ESRI aerial imagery;
- Scotland's Soils digital soil mapping (Scotland's Environment, 2024[6]); and
- SEPA Future Flood Maps (SEPA, 2023[7]).

2.2.1.3 These sources have been used to provide information on the:

- Hydrogeological setting;
- Topography; and
- Drainage or local features that may alter groundwater levels.

2.2.2 Field surveys

2.2.2.1 Habitat surveys were completed across the study area as part of the biodiversity baseline surveys, to establish Phase 1 habitat types. During the Phase 1 habitat surveys, surveyors recorded where there may be the potential to support GWDTEs. For these areas, further detailed habitat surveys were

completed to establish the presence of NVC communities. A full methodology and detailed results are presented in Volume 5, Chapter 3: Terrestrial Ecology and Biodiversity.

2.2.2.2 Initial Phase 1 habitat surveys identified one main area to undertake NVC. This was in the south of the study area (within the OnTI RLB) near New Deer. Within this area, the surrounding land was considered as potentially an area which would provide the right conditions to support GWDTEs. No other areas within the OnTI RLB were highlighted as having the potential to support GWDTEs during the Phase 1 habitat surveys.

2.2.2.3 A peat probing and NVC survey that considered GWDTE was carried out by Botanaeco in July 2023. The survey was limited to the area of mapped Class 1 peat within the OnTI RLB (referred to as "Site 5" within the New Deer substation sites: Habitats, peat & GWDTE report in Volume 7E, Appendix 7-2: Peat Survey Reports).

2.2.2.4 These surveys and associated assessment of habitat/vegetation condition and groundwater dependency identified one area of moderate groundwater-dependency for an area of 'M23b marshy grassland'.

2.2.2.5 A second peat probing survey and NVC survey was undertaken by Botanaeco in 2024 (see Volume 7E, Appendix 7-2: Peat Survey Reports), however this survey did not include an assessment of GWDTE. No peat soils were identified during this survey. The additional parcels of land surveyed in 2024 included the following habitats: MG7a *Lolium perenne* leys and related grasslands; *Lolium perenne-Trifolium repens* leys; U4b *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland; *Holcus lanatus-Trifolium repens* sub-community; and MG6a *Lolium perenne-Cynosurus cristatus* grassland, typical sub-community. These habitats are not considered to be potential GWDTEs in SEPA or WFD UK Technical Advisory Group (UKTAG) GWDTE guidance, and therefore do not require further assessment. Further information regarding SEPA and UKTAG is provided in Section 2.3 Assessment methodology.

2.2.2.6 Hydrological surveys were completed across the study area, with details presented in Volume 5, Chapter 6: Hydrology and Hydrogeology. Walkover surveys collected data on the physical attributes of watercourses, and any surface groundwater interactions that were visible.

2.3 Assessment methodology

2.3.1.1 A GWDTE is defined as within the UKTAG report (UK Technical Advisory Group, 2004[8]):

"A terrestrial ecosystem of importance at Member State level that is directly dependent on the water level in or flow of water from a groundwater body (that is, in or from the saturated zone). Such an ecosystem may also be dependent on the concentrations of substances (and potential pollutants)

within that groundwater body, but there must be a direct hydraulic connection with the groundwater body."

2.3.1.2 In line with the guidance provided in UKTAG report (UK Technical Advisory Group, 2004[8]), a dual ecological and hydrogeological approach to identifying GWDTE has been used. This involves a study of vegetation communities in order to determine the potential level of groundwater dependency, combined with a hydrogeological study in order to predict the level of interaction between ground water and the potentially dependant habitats.

2.3.1.3 Determining groundwater dependency is complex as most water-dependent terrestrial ecosystems rely on a combination of groundwater, surface water and rainwater, and many vegetation communities will use whatever source of water is available. This assessment takes the conservative estimation, where there are uncertainties, and may suggest further detailed surveys and assessment to be undertaken at detailed design stage.

2.3.1.4 The study area is reviewed to identify locations with NVC habitats that require assessment. Consideration is required for sensitive habitats that lie within 100m of areas likely to be excavated to less than 1m in depth, or within 250m of excavations deeper than 1m, as per SEPA Guidance Note 31 (SEPA, 2017[4]).

2.3.2 Assumptions

2.3.2.1 For the purposes of this assessment, it is assumed that construction within the OnTI RLB for the Onshore Export Cable Route would require excavating to greater than 1m depth and that the foundations for the Onshore Substations would require excavation to 0.75m depth.

3 Baseline

3.1 Existing habitats

3.1.1.1 The majority of the study area consists of agricultural land used for crops or livestock grazing, with low ecologically sensitive grasslands. NVC surveys highlight that there are very few areas of potentially highly groundwater-dependent habitats within the study area.

3.1.1.2 Table 3-1 presents the NVC communities that are potentially groundwater dependent recorded within the study area, including their combined total area and how these are classified within the SEPA Guidance Note 31 (SEPA, 2017[4]) and UKTAG (UKTAG, 2009[9]) guidance.

Table 3-1: Potentially groundwater dependent NVC communities present within study area

NVC Classification	Total area (m^2)	SEPA groundwater dependency	UKTAG groundwater dependency
MG10a *Holcus lanatus-Juncus effusus* rush-pasture, typical sub-community	8,500	Moderately groundwater dependent[i]	Moderate
MG9 *Holcus lanatus-Deschampsia cespitosa* grassland	600	Moderately groundwater dependent[i]	Moderate
M23b *Juncus effusus/acutiflorus-Galium palustre* rush-pasture, *Juncus effusus* sub-community	69,200	Highly groundwater dependent[i]	High

3.1.1.3 There are three NVC communities recorded which are likely to be groundwater dependent, spread across six areas. Community M23b *Juncus effusus/acutiflorus-Galium palustre* rush-pasture, *Juncus effusus* sub-community is predominantly found on wet, moderately acid to neutral peaty and mineral soils, in the lowlands and upland fringes and considered to be high to moderately groundwater dependant. Community MG10a *Holcus lanatus-Juncus effusus* rush-pasture, typical sub-community, is a rushy, wet grassland community typically found on lowland farmland with impeded drainage on flat ground or gentle slopes. MG10a *Holcus lanatus-Juncus effusus* rush-pasture, typical sub-community is typically moderately groundwater dependant.

[i] Depending on the hydrological setting

3.1.1.4 These habitat types are located in six parcels in the south of the study area within the OnTI RLB where the Onshore Export Cable Corridor (ONEC) and Onshore Substation Site meets.

3.1.1.5 There is a field drain that flows between the areas, and the Unnamed Tributary of the Burn of Asleid 1 flows south at the bottom of a slight slope adjacent to the two areas of M23b *Juncus effusus/acutiflorus-Galium palustre* rush-pasture*, Juncus effusus* sub-community and the two areas of MG10a *Holcus lanatus-Juncus effusus* rush-pasture, typical sub-community.

3.1.1.6 One of the areas of M23b *Juncus effusus/acutiflorus-Galium palustre* rush-pasture*, Juncus effusus* sub-community is located within the southern extent of the study area, south of the Unnamed Tributary of the Burn of Asleid 1. The other area of M23b *Juncus effusus/acutiflorus-Galium palustre* rush-pasture*, Juncus effusus* sub-community is located north east of this parcel, west of the Unnamed Tributary of the Burn of Asleid 1.1. One area of MG10a *Holcus lanatus-Juncus effusus* rush-pasture, typical sub-community is located east of the Unnamed Tributary of the Burn of Asleid 1.1, with a second area of MG10a *Holcus lanatus-Juncus effusus* rush-pasture, typical sub-community located south east of it.

3.1.1.7 Within each of the two areas of M23b *Juncus effusus/acutiflorus-Galium palustre* rush-pasture*, Juncus effusus* sub-community, there are small parcels of MG9 *Holcus lanatus-Deschampsia cespitosa* grassland. This habitat is associated with poorly drained permanent pastures and is moderately groundwater dependent.

3.1.1.8 The location of the potential GWDTEs is presented in Figure 6-3: Potential Ground Water Dependent Terrestrial Ecosystems (GWDTEs) within Volume 7E, Appendix 6-6: Hydrology and Hydrogeology Figures.

3.2 Groundwater availability

3.2.1.1 The hydrogeological baseline of the study area around the southern area of the OnTI RLB where the potential GWDTE have been identified, indicates the following in relation to groundwater availability at or near the surface:

- There are a number of private water supply records in the local area, however the exact locations of the extractions are not known.
- There are a number of wells recorded in the study area, with two in the vicinity of the potential GWDTEs.
- There are no springs recorded in the local area.
- Terrain maps indicate that the area of potential GWDTEs is located within a wider landscape of low-lying topography, in a dip between a number of hills and mounds.

- The bedrock geology is Southern Highland Group, a low productivity aquifer with small amounts of groundwater in near surface and in secondary fractures.
- An area of peat is mapped partially under the potential GWDTE habitat, with the soil type of mineral gleys identified on the National Soil Map of Scotland (Scotland's Environment, 2013[6]).

3.2.1.2 The existing baseline indicates that there is very little potential for groundwater to be in connection with the surface habitats.

4 Assessment

4.1.1.1 The study area has been reviewed to identify locations with NVC habitats that require assessment. Consideration is required for sensitive habitats that lie within 100m of areas likely to be excavated to less than 1m in depth, or within 250m of excavations deeper than 1m[4].

4.1.1.2 For the purposes of this assessment, it is assumed that construction within the ONEC would require excavating to greater than 1m depth and that the foundations for the Onshore Substations would require excavation of 0.75m depth. Therefore, a buffer zone of 250m and 100m was used around sensitive habitats identified in Section 3 of this document for the purposes of this assessment. An overview map of the GWDTE study area, showing locations with potential GWDTE is provided in Figure 6-3: Potential Ground Water Dependent Terrestrial Ecosystems (GWDTEs) within Volume 7E, Appendix 6-6: Hydrology and Hydrogeology Figures.

4.1.1.3 The assessment of potential GWDTE is presented in Table 4-1. The outcome after assessment is given in the 'Revised Groundwater Dependency' row, following review all areas were considered to have low groundwater dependency and are not considered sensitive to groundwater alterations as a result of the Proposed Development (Onshore).

Table 4-1: Potential GWDTE assessment

	GWDTE Area 1	GWDTE Area 2	GWDTE Area 3	GWDTE Area 4	GWDTE Area 5	GWDTE Area 6
Size (m^2)	42,300	300	26,900	300	4500	4000
NVC classification	M23b	MG9	M23b	MG9	MG10a	MG10a
Initial groundwater dependency	High	Moderate	High	Moderate	Moderate	Moderate
Relative location	South of study area, near to the Onshore Substation Site. Within southern extent of the OnTI RLB, south of the Unnamed Tributary of the Burn of Asleid 1	South of study area, near to the Onshore Substation Site. Within southern extent of the OnTI RLB, south of the Unnamed Tributary of the Burn of Asleid 1. Within GWDTE Area 1.	South of study area, near to the Onshore Substation Site. Within the southern extent of the OnTI RLB, west of the Unnamed Tributary of the Burn of Asleid 1.1.	South of study area, near to the Onshore Substation Site. Within the southern extent of the OnTI RLB, west of the Unnamed Tributary of the Burn of Asleid 1.1. Within GWDTE Area 3.	South of study area, near to the Onshore Substation Site. Adjacent to south-west boundary of OnTI RLB, east of the Unnamed Tributary of the Burn of Asleid 1.1.	South of study area, near to the Onshore Substation Site. South- west of GWDTE Area 3.
Assessment	The potential GWDTE is situated on low-lying land, which limits the capacity for groundwater recharge to the site. As a result, groundwater	The potential GWDTE is situated on low-lying land, which limits the capacity for groundwater recharge to the site. As a result, groundwater	The potential GWDTE is situated on low-lying land, which limits the capacity for groundwater recharge to the site. As a result, groundwater	The potential GWDTE is situated on low-lying land, which limits the capacity for groundwater recharge to the site. As a result, groundwater	The potential GWDTE is situated on low-lying land, which limits the capacity for groundwater recharge to the site. As a result, groundwater	The potential GWDTE is situated on low-lying land, which limits the capacity for groundwater recharge to the site. As a result, groundwater

	GWDTE Area 1	GWDTE Area 2	GWDTE Area 3	GWDTE Area 4	GWDTE Area 5	GWDTE Area 6
	recharge is only likely to be present at the western end of the site where it adjoins the foot of a slope (that has the potential for an aquifer). In addition to this, the habitat is underlaid by a pocket of peat. The presence of peat and gley soils indicates that the area is predominantly fed by rainwater which does not drain away. Both peat and gley soils are likely to act as a barrier between groundwater in the bedrock and the surface.	recharge is only likely to be present at the western end of the site where it adjoins the foot of a slope (that has the potential for an aquifer). In addition to this, the habitat is underlaid by a pocket of peat. The presence of peat and gley soils indicates that the area is predominantly fed by rainwater which does not drain away. Both peat and gley soils are likely to act as a barrier between groundwater in the bedrock and the surface.	recharge is only likely to be present at the western end of the site where it adjoins the foot of a slope (that has the potential for an aquifer). In addition to this, the habitat is underlaid by a pocket of peat. The presence of peat and gley soils indicates that the area is predominantly fed by rainwater which does not drain away. Both peat and gley soils are likely to act as a barrier between groundwater in the bedrock and the surface.	recharge is only likely to be present at the western end of the site where it adjoins the foot of a slope (that has the potential for an aquifer). In addition to this, the habitat is underlaid by a pocket of peat. The presence of peat and gley soils indicates that the area is predominantly fed by rainwater which does not drain away. Both peat and gley soils are likely to act as a barrier between groundwater in the bedrock and the surface.	recharge is only likely to be present at the western end of the site where it adjoins the foot of a slope (that has the potential for an aquifer). In addition to this, the habitat is underlaid by a pocket of peat.	recharge is only likely to be present at the western end of the site where it adjoins the foot of a slope (that has the potential for an aquifer). In addition to this, the habitat is underlaid by a pocket of peat.
Revised groundwater dependency	Moderate	Low	Moderate	Low	Low	Low

5 Monitoring and mitigation

5.1.1.1 Best practice mitigation will be adhered to by the Proposed Development (Onshore) through implementation of a Construction Environmental Management Plan (CEMP). These measures include:

- In areas of wet or marshy ground, and where the OnTI crosses up or down notable slopes, placement of clay bunds or alternative impermeable material will be included for every 0.5m change in elevation along the length of the cable trench, to minimise in-trench groundwater flow;
- In areas of potential GWDTE, rewetting of these areas should be undertaken (under supervision of an Ecological Clerk of Works (ECoW) during prolonged dry spells and decreased water table as a result of the proposed works;
- Monitoring of groundwater levels for works in close proximity to potential GWDTEs should be undertaken by an ECoW, including any excavation north of Area 1 and 3 (Figure 6-3: Potential Ground Water Dependent Terrestrial Ecosystems (GWDTEs) within Volume 7E, Appendix 6-6: Hydrology and Hydrogeology Figures), to prevent disconnection from its groundwater source in the slope above. Monitoring of levels should take into account baseline and post construction levels to ensure the water table has recovered;
- Removing protective layers of soil and superficial deposits makes groundwater vulnerable to pollution from leaks or spills from vehicles or equipment used during construction. In addition to best practice and adherence to GPP such as GPP22: Dealing with spills[10], earthworks will be kept to a practical minimum within these areas to reduce the area of sensitive habitats such as GWDTE and wetland affected by the construction works; and
- Water collecting in excavations for the Onshore Export Cable Route and Onshore Substations will be removed into settlement ponds or an equivalent alternative to allow for the removal of suspended sediment. Treated water will not be discharged directly upslope of, or within, identified sensitive habitat areas, such as GWDTE, to minimise the potential for water and nutrient flushing in these areas.

6 References

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