



Blair Hill Wind Farm

Technical Appendix 10.3

Groundwater Dependent Terrestrial Ecosystems Risk Assessment

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Date	September 2024
Ref	6389

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1 Introduction

This technical appendix provides an assessment of potential areas of Groundwater Terrestrial Ecosystems (GWDTEs) identified at the Proposed Development and considers actual groundwater dependency of these habitats, and if relevant, any impact the Proposed Development may have.

This hydrological assessment of identified GWDTEs, follows on from the conclusions of the National Vegetation Classification (NVC) survey report presented within Chapter 8 of the EIA Report. The hydrological assessment was undertaken by reviewing desk-based information including topography, watercourses, geology etc. combined with notes and photographs taken during hydrological walkovers of the Site.

2 Baseline Conditions

2.1 Main Site

A detailed (NVC) survey was completed, as outlined in Chapter 8. From the NVC survey data, communities have been identified that have the potential to be highly or moderately groundwater dependent in accordance with Scottish Environment Protection Agency Land Use Planning System Guidance Note 31 (SEPA-LUPS-GU31)¹.

In accordance with SEPA-LUPS-GU31, the following infrastructure buffers would be implemented to survey areas for potential GWDTE:

- Within 100 m radius of all excavations less than 1 m in depth; and
- Within 250 m of all excavations deeper than 1 m.

In accordance with guidance, only potential GWDTE communities within these 100 m and 250 m buffers have been scoped into assessment, as shown in Annex 2 Drawing 1.

The following potential GWDTE communities were identified, with potential high or moderate groundwater dependency, based on SEPA-LUPS-GU31, shown in brackets:

- M6a/M6b/M6c/M6d (High);
- M23a/M23b (High);
- CG10 (High);
- W4/W4c (High);
- W7/W7c (High);
- M15b/M15d (Moderate);
- M25/M25a/M25b (Moderate);
- M27 (Moderate);
- MG10/MG10a (Moderate);
- U6 (Moderate); and
- W6 (Moderate).

A review of the baseline features that may affect the groundwater dependency was undertaken in Chapter 10. The Site is characterised by wacke of the Shinnel Formation bedrock², with mudstone of the Moffat Shale Group and wacke of the Gala Unit underlying the access track in the south-east. There are localised superficial deposits underlying the Site of peat (>0.5 m), deep peat (>1 m) and till, with alluvial deposits present along larger watercourses. The Site is divided between River Cree,

¹ SEPA. (2017). Land Use Planning System SEPA Guidance Note 31 Available at: <https://www.sepa.org.uk/media/144266/lups-gu31-guidance-on-assessing-the-impacts-of-development-proposals-on-groundwater-abstractions.pdf>. Accessed on: 12 July 2024.

² BGS (2023) Online GeolIndex Map Viewer. Available at: <https://mapapps2.bgs.ac.uk/geolindex/home.html>. Accessed on: 11 June 2024.

Penkiln Burn and Palnure Burn surface water catchments, and there are several named and unnamed tributaries that originate onsite³. The Penkiln Burn and Palnure Burn watercourses confluence and drain into the River Cree, prior to discharge into the Bladnoch and Cree Estuary. The Site is characterised by large areas of plantation forestry, with habitats of blanket bog, wet modified bog, unimproved acid grassland, marsh/marshy grassland and continuous bracken present in the north and south. There is surface water overland flow associated with forestry rides and artificial drainage along existing tracks.

A review of the baseline features including topography, underlying geology, and surface water features, was undertaken to determine the groundwater dependency for each group of habitats. This is shown in Table 1 in Annex 1. Following this, identified mosaics of potential GWDTes were scoped into further assessment. This included review of Site observations from the hydrological walkover.

During the Site walkover observations were noted on the following:

- Ground conditions including surface wetness;
- Peat depth;
- Habitat type;
- Topography;
- Breaks in slope or slumps present; and
- Identification of any springs or flushes.

These observations combined with the desk-based assessment are shown in Table 2 in Annex A, with the revised groundwater dependency.

2.2 Access Track

NVC potentially highly and moderately dependent mosaics located along the access track were assessed separately due to the differing baseline conditions present along the existing track. The baseline features for this area included the existing forestry access track and Auchinleck Bridge. The existing forestry access track has trackside drainage present, along with cross-drainage culverts, designed to maintain hydrological connectivity upslope and downslope of the track. There are numerous watercourses and minor streams present widespread across the area, which are largely tributaries of the Glenshalloch Burn and Penkiln Burn. Tributaries to the south-east at the Site entrance drain to the Palnure Burn. While no deposits of deep peat were identified during peat probing, BGS GeolIndex Onshore identifies that an area along the Penkiln Burn is underlain by alluvium. There are no underlying faults present, except to the south-east near the Site entrance. The bedrock aquifers underlying the area are low productivity and limited groundwater is present in secondary fractures.

During the Site visit no point or diffuse sources of groundwater were identified. The GWDTes present were identified to be associated with either the large number of minor streams present or with present trackside drainage. Due to this, GWDTes were determined to be largely dependent on surface water flow and are scoped out of potential risks from the Proposed Development.

3 Mitigation

Best practice mitigation and guidance for protection of surface and groundwater receptors will be followed throughout the construction phase. This includes embedded mitigation that all infrastructure will be sited outwith the 100 m and 250 m buffers from actual GWDTes.

Primary mitigation is outlined within Chapter 10 in Section 10.8.

³ SEPA. (2023). Online Water Environment Hub and Classification Hub. Available at: <https://www.sepa.org.uk/data-visualisation/water-environment-hub/>. Accessed on: 11 June 2024.

4 Summary and Conclusions

As outlined within Annex 1 Table 2, all potential GWDTEs identified have been assessed to be of low groundwater dependency.

As outlined in Section 1.2, the geology of the Site is defined as cycles of low permeability sedimentary rocks of wacke and mudstone, of low productivity with groundwater associated with near-surface and secondary fractures. There are also numerous minor watercourses present onsite with significant overland surface water flow across the slopes. Ombrotrophic habitats of blanket bog and wet modified bog are also present.

As defined in detail within Annex 1, the following have been determined to result in potential high or moderate GWDTE mosaics having been assessed to be of low groundwater dependency:

- Mosaics are located along watercourses, minor streams, artificial and existing trackside drainage, indicating their dependence on surface water flow rather than groundwater.
- Mosaics are underlain by low permeability till or peat, which limit any vertical connectivity to underlying limited groundwater.
- Mosaics across the entire Site are underlain by low productivity bedrock aquifers, which has limited groundwater present associated with secondary fractures, which are not widespread across the Site.
- Habitats of wet modified bog and blanket bog habitats are present. Many mosaics are located downslope of these areas fed by surface water flushes from these ombrotrophic habitats.
- No point or diffuse groundwater emergence was identified onsite.

Due to the above, GWDTEs have been scoped out of further assessment, and no additional mitigation is required. Embedded and best practice mitigation measures will still be in place to protect surface water and groundwater receptors.

Annex 1

Table 1 below is to be read in conjunction with Drawing 1 in Annex 2.

Table 1: Desk-Based Review of Potential Groundwater Dependency

Potential Groundwater Dependency	NVC Communities	Phase 1 Habitat	Location	Description of Baseline Features	Scoped In/Out of Further Assessment
High (Highly Dominant) Mosaics	High: M6a, M6c, M6d, M23a, M23b Moderate: M15d, M25, M25a	Acid neutral flush	There are 19 mosaics located in the north and south of the Site, located on moderate and steep slopes.	Often located in headwaters of small burns, located in close proximity to faults in some places, underlain by low productivity aquifer characterised by fracture flow. Largely not shown to be underlain by superficial deposits on BGS maps. Probing indicates minimal underlying peat deposits, although deep peat deposits are often present upslope. Noted to be often located downslope of blanket bog or wet modified bog.	These mosaics are scoped in to further assessment. While most mosaics are expected to be ombrotrophic and fed from surface water runoff from surrounding wet habitats of wet modified and blanket bog, it is deemed necessary to combine this desk-based review with onsite observations.
High (Highly Sub-dominant) Mosaics	High: M6c, M6d Moderate: M15d, M25, M25a	Blanket bog, Wet modified bog, Marsh/marshy grassland, Unimproved acid grassland, Wet dwarf shrub heath	These 15 mosaics are located on the northern slopes of the Site with two mosaics present in the centre. These circular mosaics cover large areas, except some which are linear following watercourses. Mosaics are located on moderate to gentle slopes.	Often located in close proximity or are bound by watercourses. Although underlain by low productivity bedrock aquifers, in the north of the Site mosaics are underlain by several faults. Largely underlain by minimal peat, although deeper peat is present in some locations. BGS notes that areas of mosaics are underlain by low permeability till and peat deposits.	Mosaics in the centre of the Site which are underlain by peat and till are scoped out of further assessment. Mosaics in the north of the Site are scoped in to further assessment where there is limited superficial deposits shown and faulting indicated. Mosaics which are underlain by till and peat in the north have been scoped out.

Potential Groundwater Dependency	NVC Communities	Phase 1 Habitat	Location	Description of Baseline Features	Scoped In/Out of Further Assessment
Moderate (Moderately Dominant) Mosaics	Moderate: M15d, M15b, M25, M25a, MG10a	Wet dwarf shrub heath, Marsh/marshy grassland, Dry heath/acid grassland	There are 29 mosaics located in the furthest north and in the south of the Site. The polygons are irregularly shaped, located on moderate to lower gradient slopes.	Often located upslope or bound by watercourses. Although underlain by low productivity bedrock aquifers, in the north of the site mosaics are underlain by several faults. BGS shows largely no superficial deposits present, with till present downslope. Peat probing indicates limited peat deposits are present. In the south mosaics are often located in close proximity to bracken habitat. In the north mosaics are located in close proximity to wet modified bog and small areas of blanket bog.	Mosaics in the north of the Site are located downslope of ombrotrophic blanket bog and wet modified bog habitats, which are scoped out. This excludes mosaics in the north of the Site (near T1) which are underlain by faults, which are scoped in. Mosaics in the south are scoped out due to the underlying low productivity bedrock, minimal faulting shown, and areas associated with watercourses or with gentle slopes.
Moderate (Moderately Sub-dominant) Mosaics	Moderate: M15b, M15d, M25a, U6	Blanket bog, and Wet modified bog (largely in the north). Continuous bracken, and Dry acid heath/acid grassland (largely in the south).	There are 22 mosaics located in the north and south of the Site. The polygons are irregularly shaped or linear following watercourses. Located on moderate to lower gradient slopes.	Often located in close proximity or immediately upslope of watercourses. Largely shown by BGS to not be underlain by superficial deposits. The depth of peat shown underlying the mosaics is largely limited but is deep in isolated areas. The mosaics are underlain by low productivity bedrock with no faulting shown. In the north the polygons are surrounded by wet modified bog and blanket bog mosaics. In the south by small areas of blanket bog, and larger areas of bracken, marsh/marshy grassland and wet dwarf shrub heath.	These mosaics are scoped out of further assessment. Mosaics in the north are located in headwaters of watercourses and underlain by deeper peat deposits. These mosaics are largely ombrotrophic wet modified and blanket bog, surrounded upslope and fed by other rain-fed habitat mosaics. Mosaics in the south are underlain by low productivity bedrock with no faulting noted. These mosaics are located on moderate gradients above any break in slopes.

Table 2: Mosaic Specific Revised Groundwater Dependency

Mosaic Polygon ID	NVC Communities (potential GWDTE)	Potential Groundwater Dependency	Description of Baseline Features	Site Visit Observations	Revised Groundwater Dependency	Justification
B004, B008	M6a, M6c, M6d	Highly Dominant	Located immediately downslope of wet modified bog habitats. Peat deposits present upslope. Located on moderate slopes, underlain by low productivity bedrock with no faults noted.	Upslope bare peat identified with flushes from upslope bog habitat. Noted to be very wet underfoot.	Low	Will be largely fed from surface water flushes from upslope ombrotrophic habitats present.
B016	M6d	Highly Dominant	Underlain by low productivity bedrock aquifer, with no underlying faults noted, and partly underlain by till. Located downslope of dry heath/acid grassland and wet modified bog. Located alongside small watercourse.	Upslope of mosaic noted to be wet underfoot, with surface runoff from upslope bog. Downslope beside watercourse there are minor watercourses and surface water flow noted.	Low	Mosaic largely fed by surface water runoff from wet modified bog and ombrotrophic habitat upslope, with small drains crossing the mosaic to watercourse downslope.
B049, F041	M6d	Highly Dominant	Dry heath and acid grassland habitats located upslope. Underlain by low productivity bedrock aquifer, no faults noted, and no underlying superficial deposits.	B049 located on convex brow of hill, no break in slope present, dry underfoot across mosaic.	Low	Located upslope of any change in gradient with no point or diffuse source of groundwater identified onsite.
B070	M6c, M6d, M23a, M25	Highly Dominant	Upslope located on break in slope downslope of peat deposits. Surrounded by wet modified bog and blanket bog habitats. Located beside watercourse.	Upslope bare peat identified with flushes from upslope bog habitat. Noted to be wet underfoot with ephemeral streams present.	Low	Fed by surface water overland flow from ombrotrophic habitats upslope to watercourse present downslope.

Mosaic Polygon ID	NVC Communities (potential GWDTE)	Potential Groundwater Dependency	Description of Baseline Features	Site Visit Observations	Revised Groundwater Dependency	Justification
E011, E013, F012	M6d	Highly Dominant	Located on gentle slopes downslope of wet modified bog and blanket bog habitats. Underlain by deep peat deposits.	Flat lying area, very boggy with exposed peat and very wet underfoot. Small drains present within mosaic.	Low	Fed by surface water overland flow from ombrotrophic habitats upslope to watercourses present downslope.
E043	M6d, M15d	Highly Dominant	Located on steep slopes along Cordorcan Burn. Bound by habitats of wet dwarf shrub heath and marsh/marshy grassland.	Steep water shedding slopes with overland flow towards watercourse.	Low	Fed by precipitation and surface water flow towards watercourse.
E045, E046	M6d	Highly Dominant	Located downslope of wet dwarf shrub heath, upslope of blanket bog. No peat deposits noted, underlain by impermeable till. Fault present underlying E045.	Noted to be dry underfoot with no groundwater emergence noted.	Low	Underlain by impermeable till limiting vertical connectivity, with no groundwater sources identified onsite. Supplied by precipitation and surface water overland flow.
N149	M6d, M25a	Highly Dominant	Located on moderate slope, underlain by peat and surrounded by deep peat. Located beside plantation forestry.	Very wet underfoot with surface water flow visible over vegetation. Fed by artificial forestry drains.	Low	Underlain by impermeable peat, suggesting ombrotrophic, with surface water supplied by artificial drains.
N157	M6c, M6d, M23b, M25a	Highly Dominant	Underlain by low productivity bedrock, with no faults or superficial deposits shown. Surrounded by marsh/marshy grassland and blanket bog.	Located on brow of hill, noted to be dry underfoot. Underlain by shallow soils.	Low	Located upslope of any change in gradient with no point or diffuse source of groundwater identified onsite.
N226	M6d	Highly Dominant	Underlain by deposits of deep peat. Surrounded by habitats of bracken and marsh/marshy	Noted to be very wet underfoot with flush and	Low	Underlain by impermeable peat, suggesting ombrotrophic, with

Mosaic Polygon ID	NVC Communities (potential GWDTE)	Potential Groundwater Dependency	Description of Baseline Features	Site Visit Observations	Revised Groundwater Dependency	Justification
			grassland. Located on moderate slopes.	small surface water streams present.		surface water supplied by surface water flow across gently sloping area to stream downslope.
E040, E049	M15d, M6c, M6d	Highly Sub-Dominant	Partly underlain by largely impermeable till deposits, no peat deposits noted. Located on steep to moderate slopes. Surrounded by dry heath/acid grassland and wet dwarf shrub heath.	Slightly wet underfoot. No points of groundwater emergence identified. Dry slopes of grassland present upslope.	Low	Mosaics are partly underlain by largely impermeable till, disconnecting from any underlying groundwater. Located upslope of any change in gradient with no point or diffuse source of groundwater identified onsite.
F042	M6d	Highly Sub-Dominant	Underlain by low productivity bedrock, no faults or superficial deposits shown. Located in wet modified bog, downslope of blanket bog habitat.	Peat deposits present upslope. Downslope of mosaics small flushes flow to join watercourses present.	Low	Located downslope and surrounded by ombrotrophic habitats, therefore is not fed by groundwater.
E020, E021	M15d, M25	Moderately Dominant	Underlain by low productivity bedrock, partly underlain by peat and a fault. Located on moderate slopes. Located downslope of unimproved acid grassland.	Dry underfoot with some small ephemeral streams present.	Low	Located on moderate slopes with no break in topography. Dry underfoot and no obvious point or diffuse sources identified.
E024, E025	M15d	Moderately Dominant	Underlain by low productivity bedrock, partly underlain by several faults, and till downslope. Located on steep and moderate slopes. Located downslope of unimproved acid	Dry underfoot, located on brow of hill.	Low	Located on moderate slopes with no break in topography. Dry underfoot and no obvious point or diffuse sources identified.

Mosaic Polygon ID	NVC Communities (potential GWDTE)	Potential Groundwater Dependency	Description of Baseline Features	Site Visit Observations	Revised Groundwater Dependency	Justification
			grassland and wet dwarf shrub heath.			

Annex 2