Drummarnock Wind Farm – Further Environmental Information

Technical Appendix 1: Borrow Bit Appraisal

Drummarnock Wind Farm Limited

November 2025

Drummarnock Wind Farm

Preliminary Borrow Pit Appraisal

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1 Introduction

1.1 General

Gavin and Doherty Geosolutions (GDG) have been commissioned to assess preliminary locations for the temporary extraction of rock at the Proposed Wind Farm Development near Drummarnock, Stirlingshire. The site is located approximately 6.5km southwest of Stirling, in the central belt of Scotland at approximate Easting and Northing 275150, 687339. The site currently comprises a peat moorland.

The Proposed Development involves the installation of four wind turbines, along with the construction of associated infrastructure, including access tracks, hardstandings, and service routes. To facilitate construction, the use of on-site borrow pits is proposed to supply the required aggregate materials.

This report represents an update to the version submitted as part of the Environmental Impact Assessment (EIA). Since the submission of the EIA, further design refinement has taken place, informed by the ongoing engineering assessments, and environmental constraints.

This updated appraisal reflects those changes and provides a revised assessment of borrow pit suitability, considering the most recent site information and layout plans. A site location plan for the development is presented in Figure 1-1.

Figure 1-1 Site Location and Boundary

1.2 Scope of Report

This Preliminary Borrow Pit Appraisal has been prepared to identify potential on-site sources of rock required for the construction of the Proposed Wind Farm Development. The key objectives of this assessment are to:

- Identify and assess potential areas within the site suitable for rock extraction;
- Characterise the nature and extent of overlying superficial deposits; and
- Determine the underlying bedrock types present within the development area.

This appraisal has been informed by both a desk-based study and a subsequent site walkover, which was undertaken to verify and supplement the preliminary findings. It should be noted that this appraisal does not address peat stability; a separate Peat Landslide Hazard Risk Assessment is provided in Section 5.2 in the Additional Information Report.

Further intrusive site investigations will be necessary to confirm ground conditions and to validate the desk study and walkover observations. These investigations will also support the refinement of borrow pit design and inform estimates of material availability.

The assessment of potential borrow pit locations has considered factors including topography, inferred rock quality, presence of rock outcrops, and proximity to environmental and physical constraints, as identified by Atmos Consulting Ltd. These criteria are outlined in Section 3 of this report.

At this preliminary stage, rock volume estimates and borrow pit sizing have not been finalised. The configuration and extent of the borrow pits will be refined as the design process advances and further information becomes available regarding material requirements and ground conditions. The likely characteristics of the rock at the proposed borrow pit locations have been assessed based on available published geological information and literature, in absence of intrusive ground investigation data.

National Planning Framework (NPF4 Policy 33) states that "*Development proposals for borrow pits will only be supported where: i. the proposal is tied to a specific project and is time-limited; ii. the proposal complies with the above mineral extraction criteria taking into account the temporary nature of the development; and iii. appropriate restoration proposals are enforceable.*". In relation to the mineral extraction criteria, borrowing rock onsite would reduce the requirement of imported material, significantly reducing traffic on local roads during the construction phase and improving sustainability. Other considerations of environmental impact in relation to borrow pits are detailed in the EIA.

1.3 Update to EIA Submission

This report is an update to the version submitted as part of the Environmental Impact Assessment (EIA). Since that submission, further refinement of the Proposed Development layout and associated borrow pits has been undertaken. One previously proposed borrow pit locations has been removed due to site constraints, and remaining three other pits have been expanded based on updated requirements and information. This updated appraisal reflects those changes and forms part of the continued design development process.

2 Site Description

2.1 General

The site is characteristic of upland moorland terrain, predominantly covered with heather and grassland. In lower-lying and wetter areas, the vegetation transitions into boggy ground.

The topography is gently undulating, generally sloping downwards towards the east, with a number of rivers and watercourses dissecting the landscape. The highest elevation on the site is approximately 373m above Ordnance Datum (AOD) near the eastern boundary.

Aerial imagery and observations from the site walkover indicate that the land is primarily used as open moorland, with evidence of sheep grazing. A small number of dwellings are present, including a working farm and associated infrastructure located in the eastern portion of the site.

2.2 Ground Conditions

2.2.1 Superficial Deposits

Following a review of the British Geological Survey (BGS) available mapping, shown in Figure 2-1, the site is predominantly underlain by hummocky glacial till deposits, which overlain by peat. This is particularly noticeable in the western portion of the site, where glacial till is likely present underlying the peat. In the eastern area of the site, glacial till is the dominant superficial deposit, with alluvium deposits recorded adjacent to the watercourses. In localised areas across the site, no superficial deposits are recorded, which may suggest that bedrock is close to or exposed to the surface.

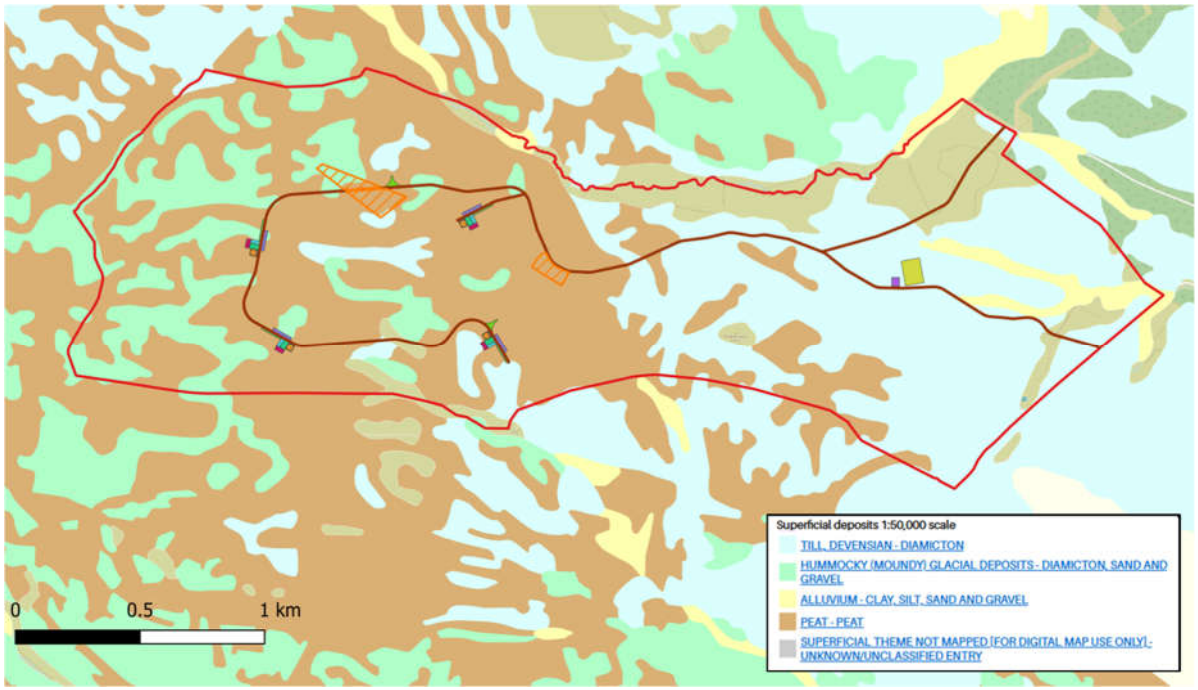


Figure 2-1 Superficial Geology (1:50,000 Maps- BGS 2025)

Peat probing has been undertaken by Atmos Consulting. Phase 1 and 2 interpolated peat depth data from the areas surveyed is presented in Figure 2-2. No consistent pattern of peat thickness is currently evident across the site; however, in areas of flatter topography, peat tends to be deeper.

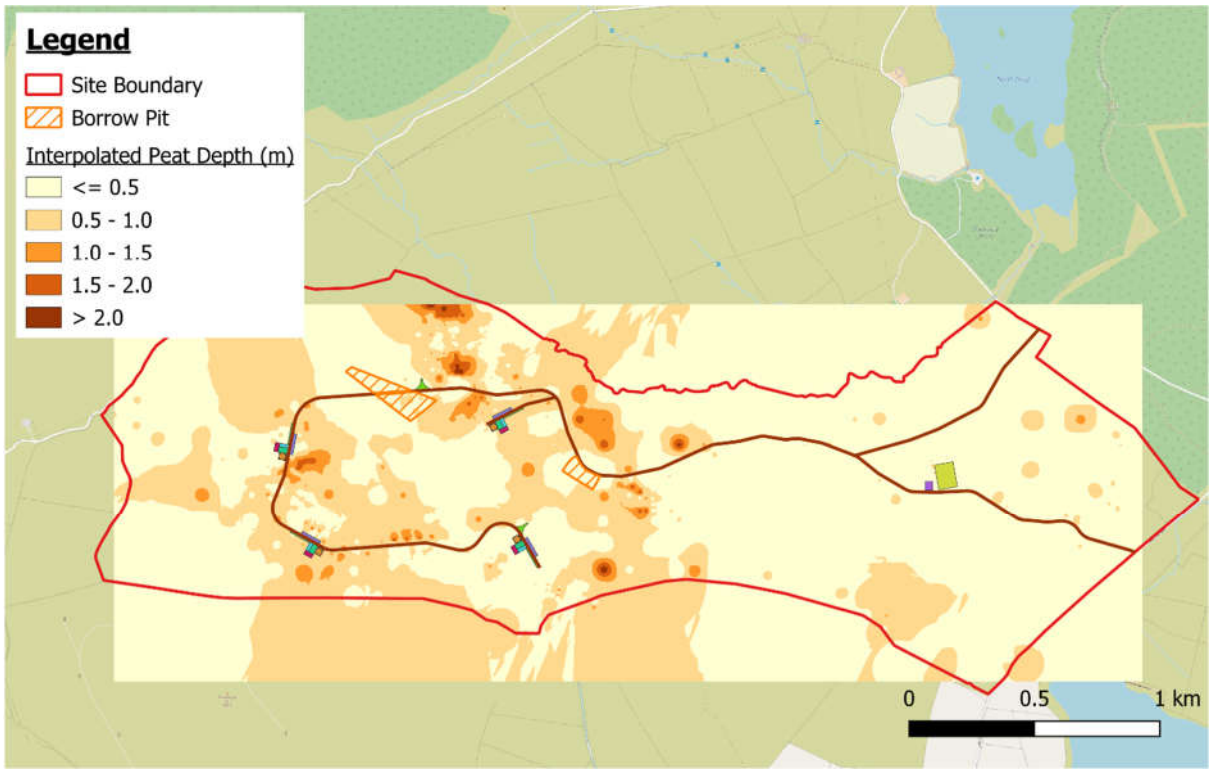


Figure 2-2 Interpolated Peat Depths (Atmos Consulting)

The BGS 1:1M Superficial Engineering Geology dataset provides further insight into the likely geotechnical behaviour of these deposits:

- **Glacial Till:** Typically described as firm to very stiff, or hard, slightly gravelly sandy clay with occasional cobbles and boulders. These materials are generally stable in short-term excavations; however, the presence of water-bearing lenses (silt, sand, gravel) and fissures can reduce stability. Portions of the glacial till may be suitable for use as cohesive general engineered fill, depending on their grading and plasticity. Shallower deposits are likely to be wetter than optimum and may require conditioning or stabilisation to be suitable for reuse. The proportion of acceptable fill material is expected to increase with depth.
- **Alluvium:** Comprising very soft to very stiff clays or silts, alluvial deposits are generally easy to excavate. However, they typically require immediate support, particularly where groundwater ingress is present. In some instances, localised stiff clay may remain temporarily stable in dry conditions. Alluvial clays are generally unsuitable for reuse as engineered cohesive fill due to elevated moisture and organic content.
- **Peat:** Characterised as very soft to firm fibrous to amorphous peat. They exhibit very low to moderate permeability, with water movement primarily through the soil matrix. Peat provides very poor foundation conditions due to its high compressibility and weakness. The presence of

acidic groundwater may pose a risk of corrosion to buried steel and concrete structures. Where practicable, peat should be removed to expose stronger underlying deposits.

Where concrete or steel is to be placed within the fill, testing for aggressive ground conditions should be undertaken in accordance with BRE Special Digest 1:2005. Generally, the material should be placed as soon as possible after excavation and subject to minimum construction traffic when wet. Material containing a significant proportion of organic material i.e., peat, is unsuitable as fill.

Where concrete or steel is proposed within these materials, ground aggressivity testing in accordance with BRE Special Digest 1:2005 is recommended. Excavated material should be placed promptly after extraction and should not be trafficked when wet. Materials with high organic content, such as peat, are unsuitable for structural fill and should be excluded.

These interpretations are based on available mapping and datasets; site investigation and laboratory testing will be required to confirm the suitability of the superficial deposits for reuse in construction.

2.2.2 Solid Geology

A review of the available BGS data indicates that the bedrock beneath the site comprises several geological units, summarised in Table 2-1 and illustrated in Figure 2-3. The predominant rock types underlying the site are basaltic and gabbroic formations, both of which are generally classified by the BGS as very strong and are considered likely to provide suitable material for general engineered fill purposes.

Table 2-1: Geological units present underlying the site

Bedrock name	British Geological Survey Description
Lower Limestone Formation	Marine limestone
Hurlet Limestone	Marine (crinoidial and shelly bioclastic) limestone
Lawmuir Formation	Cyclothymic sequences of mudstone, siltstone, sandstone with seatearths, coal and marine limestones
Gargunnock Hills Lava Member	Predominately plagioclase-macrophyric basalt and composite lavas, with subordinate plagioclase-microphytic basalt
Midland Valley Sill-Complex	Quartz-microgabbro and trace basalt

The BGS report that basaltic and gabbroic rocks may be excavated using hard digging or ripping methods in some areas; however, fresher, more intact material may be more challenging to excavate, with difficulty influenced by the spacing and orientation of geological discontinuities.

The BGS 1:1M Engineering Geology dataset provides classifications of these units for their suitability as engineered fill. Basaltic rock is deemed suitable for use as selected granular fill if careful selection and extraction practices are applied. Some basalt may undergo slight exfoliation after prolonged weathering. Fresh gabbroic rock is also considered suitable as selected granular fill.

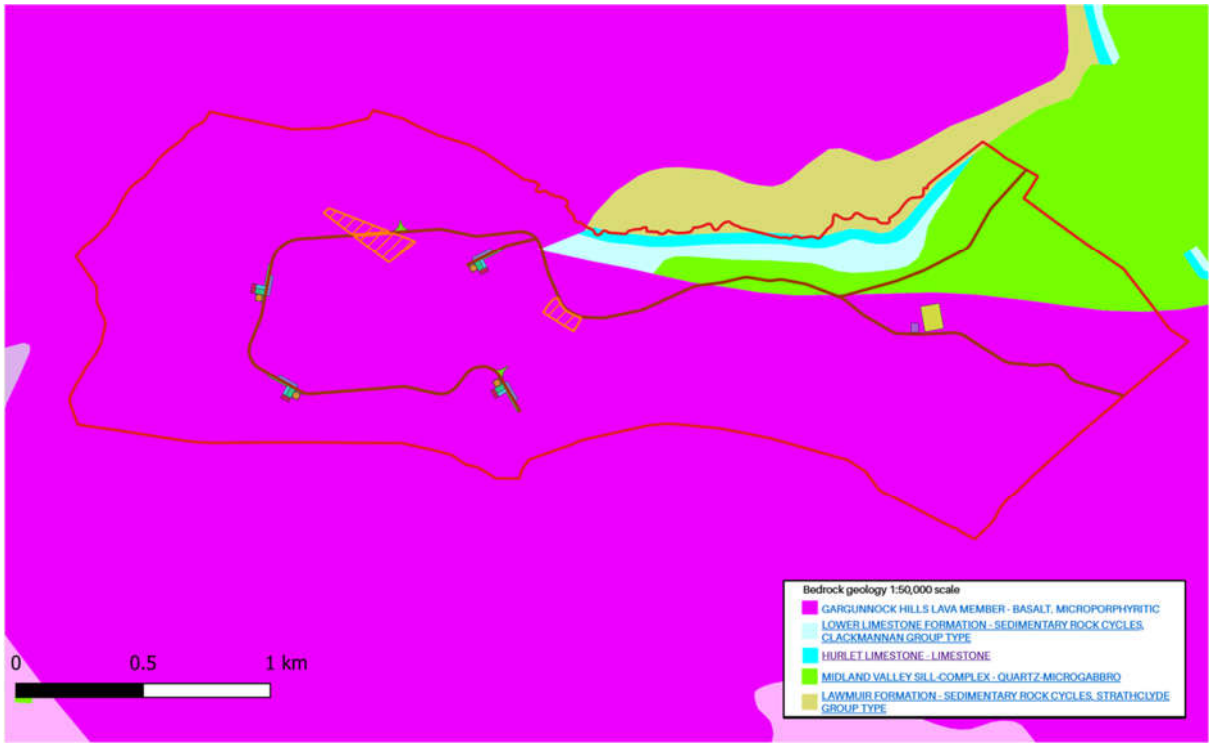


Figure 2-3 Bedrock Geology (1:50,000 Maps- BGS 2025)

During site investigation, it is critical to assess intact rock strength, the spacing, orientation, and nature of discontinuities (including groundwater flows), and the extent and depth of weathered zones. In particular, for basaltic formations, the potential presence of tuff layers and paleosols (fossilised soils beneath volcanic flows) must be evaluated.

Further site investigation and laboratory testing will be required to verify these assumptions. Additionally, the depth to rockhead will be a key factor in determining the feasibility of extracting suitable rock for construction purposes.

3 Borrow Pit Locations

3.1 General

Three potential areas have been identified for the development of borrow pits (BP02–BP04). These locations were selected following multiple phases of refinement, including a review undertaken in 2025. As part of this review, Borrow Pit BP01 was removed due to updates in environmental and physical constraints mapping provided by Atmos Consulting Ltd. In parallel, the extents of BP02, BP03 and BP04 were slightly increased in area to reflect revised assessments of accessible material and construction needs.

The proposed borrow pit locations are illustrated in Figure 3-1. Each area was identified based on predefined selection criteria, described further in Section 3.2, which considers topography, estimated rock quality, and proximity to environmental constraints.

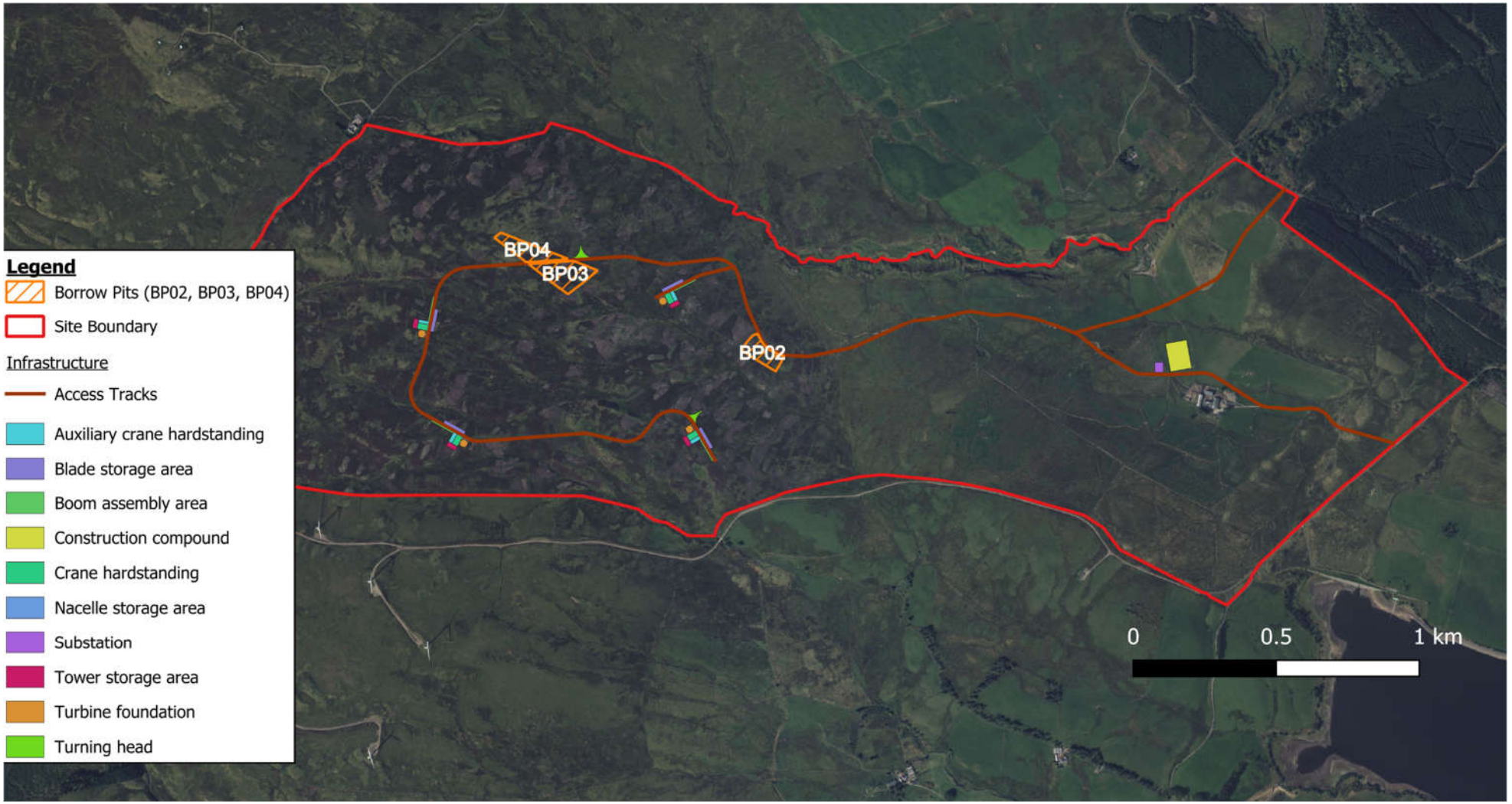


Figure 3-1 Preliminary Borrow Pit Locations

3.2 Criteria for Selection of Borrow Pit Search Area

The following criteria have been used to determine potential locations for Borrow Pit areas across the site:

- Avoiding peat depths >1m,
- Targeting areas of rock outcrop, where possible,
- Avoidance of Watercourses: the risks associated with polluting adjacent watercourses from both silt runoff and fuel and hydraulic oils. Watercourse buffers of 50m are utilised for this assessment,
- Haul distances: anticipated haul distances have been taken into consideration during the selection of potential areas. Reducing the distance between the borrow pit and the final placement has the following benefits:
    1. Reduces the volume of site traffic/number of haul vehicles, ultimately reducing the air pollution on site
    2. Reduces the Health and Safety risk
    3. Reduces tracking of vehicles in periods of wet weather when plant movements should be kept to a minimum
- Quality of rock: the site is predominantly underlain by basaltic and gabbroic rock which is expected to provide adequate aggregate for general construction purposes. However, testing is required as part of future site investigation works to determine the physical properties of the rock,
- Avoidance of Groundwater Dependent Terrestrial Ecosystems (GWDTEs): areas that are critically dependent on groundwater flows or chemistries have been surveyed by Atmos Consulting, and have been considered for this assessment, i.e., borrow pits are not located within any moderate/high-risk GWDTE's,
- Other: avoiding exclusion zones and other buffers provided by Atmos Consulting, and non-designated cultural heritage assets and objects have been taken into consideration.

3.3 Site Walkover

A site walkover was undertaken by a GDG Engineer on 18th January 2023 to observe and assess surface conditions at each of the preliminary borrow pit (BP) locations. A selection of representative photographs with associated observations is provided in Appendix A. Key findings from the walkover are summarised in Table 3-1.

Across the site, including the proposed borrow pit areas, exposed rock outcrops were limited. The ground surface was predominantly vegetated, with heather dominating sloping ground and grasses more common in flatter, boggier areas.

Where rock exposures were present, identification of lithology was restricted due to significant weathering and/or lichen-like vegetation cover. In general, exposed rock tended to occur in areas where peat depths were observed to be shallower.

Based on the visual assessment, steeper terrain, particularly within the BP03 and BP04 areas, appears more favourable for rock extraction. However, no major physical constraints were observed during the walkover that would preclude borrow pit development in any of the assessed areas.

Table 3-1 Preliminary Borrow Pit Area Descriptions

Preliminary Borrow Pit ID	Photograph Reference Number (Appendix A)	Location Description
BP02	2-10	The area of preliminary BP02 was observed to dip gently towards the southeast. Locally there were some boulders and exposed bits of bedrock, they were heavily weathered and covered in lichen-like vegetation. No large rock outcrops were observed.
BP03	11 – 17	The area within BP03 was observed to be sloping steeply to the east. In the west of the area there was a localised steeper slope with rock exposed, although was hard to identify as it was heavily weathered (photograph 15). There were a few locations where rock was outcropping from the vegetation, this is likely a result of shallow peat depths.
BP04	18 – 22	The area within preliminary BP04 was observed to steeply dip south-eastwards with localised areas of undulation and steeper slopes. There were only localised areas of rock protruding where the peat appeared shallow.

4 Conclusions and Recommendations

4.1 Conclusion

This Preliminary Borrow Pit Appraisal has been undertaken to assess the potential for temporary rock extraction to support the construction of the Proposed Wind Farm Development near Drummarnock, Stirlingshire.

Through a review of available geological data, environmental constraints, and a site walkover undertaken in January 2023, three potential borrow pit locations (BP02–BP04) have been identified as viable options. These locations have been refined following updates to site constraints and the removal of a previously considered area (BP01).

4.2 Recommendations

No ground investigations are understood to have been undertaken at the site. It is considered that site investigation, including a detailed desk study and intrusive works, will be required post-consent to characterise the soil and rock properties, and to determine final placement and design of borrow pits on site, as discussed previously in this report. Depth to rockhead will be a key consideration.

To progress the design and confirm the suitability of the proposed borrow pit areas, a comprehensive ground investigation will be required post-consent. This should include both an updated desk study and intrusive investigations to:

- Characterise the physical and engineering properties of the superficial soils and underlying rock;
- Confirm the presence, depth, and extent of workable rock;
- Assess the potential suitability of site-won material for use as structural and concrete aggregate;
- Inform the detailed design and layout of the borrow pits.

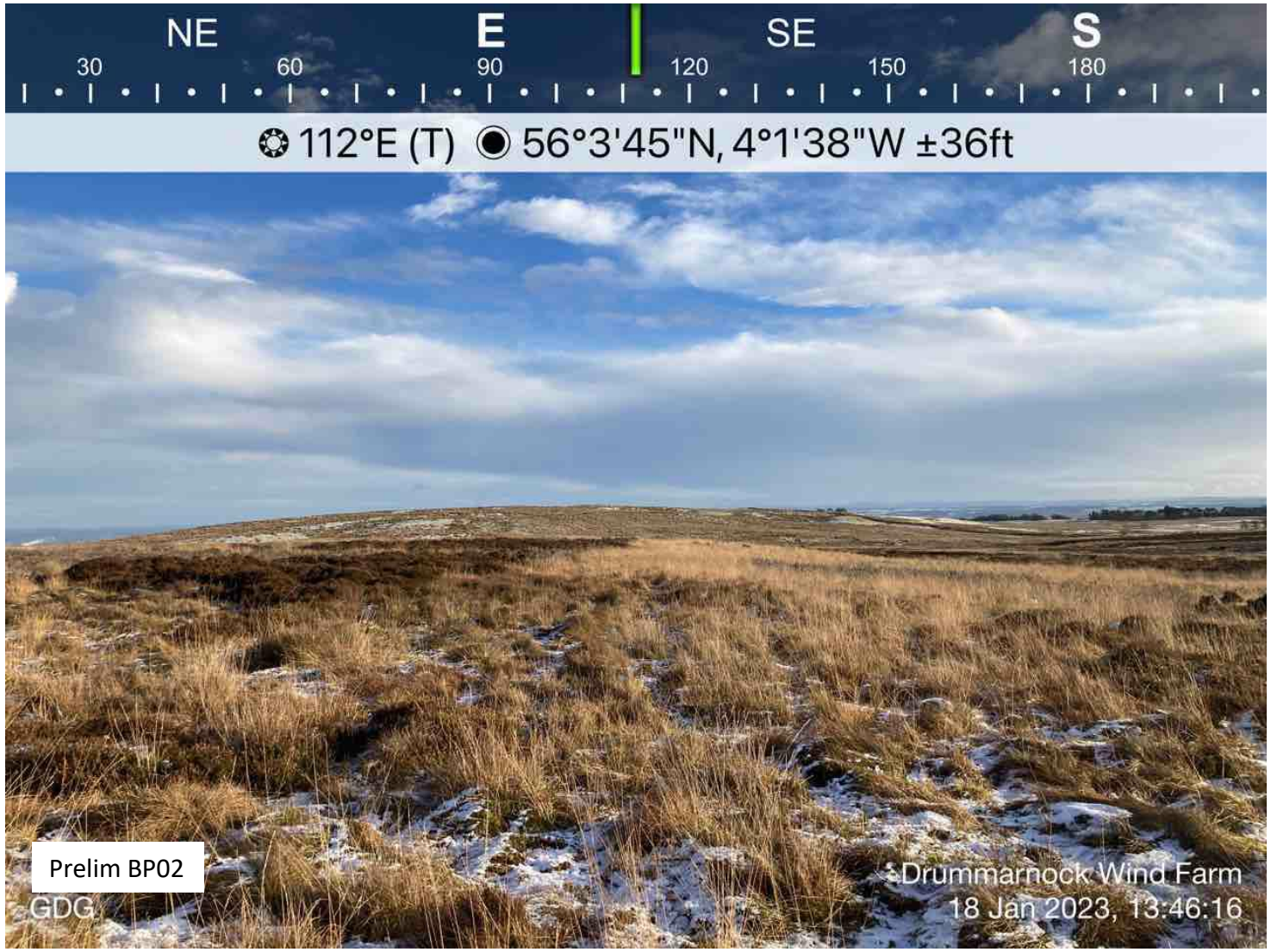
Appendix A – Site Walkover Photographs

Drummarnock Wind Farm
Preliminary Borrow Pit Appraisal

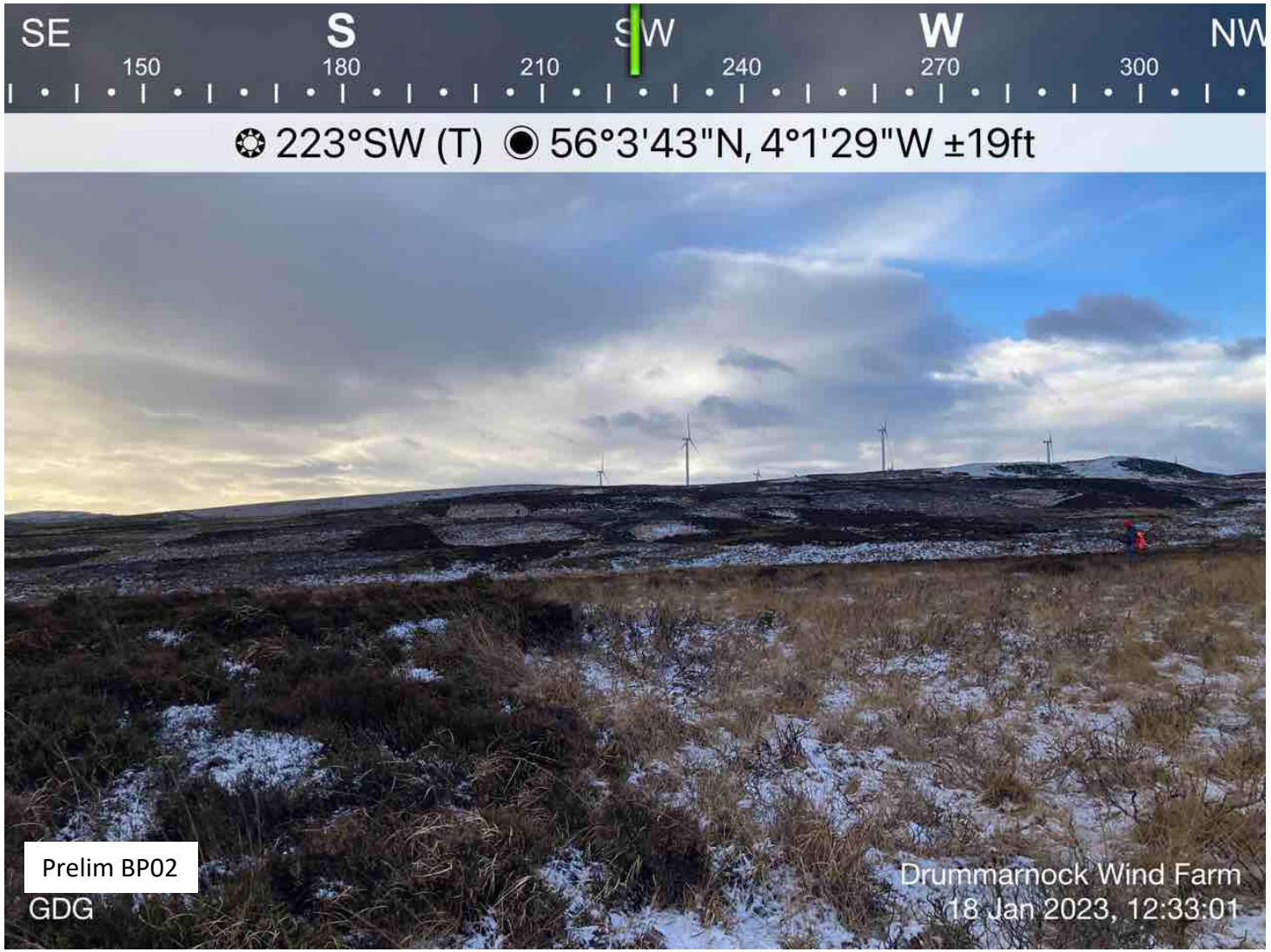
Site Walkover 18/01/2023

BP02 – Photographs and Comments

Photograph 5: View east along the northern boundary of Prelim BP02

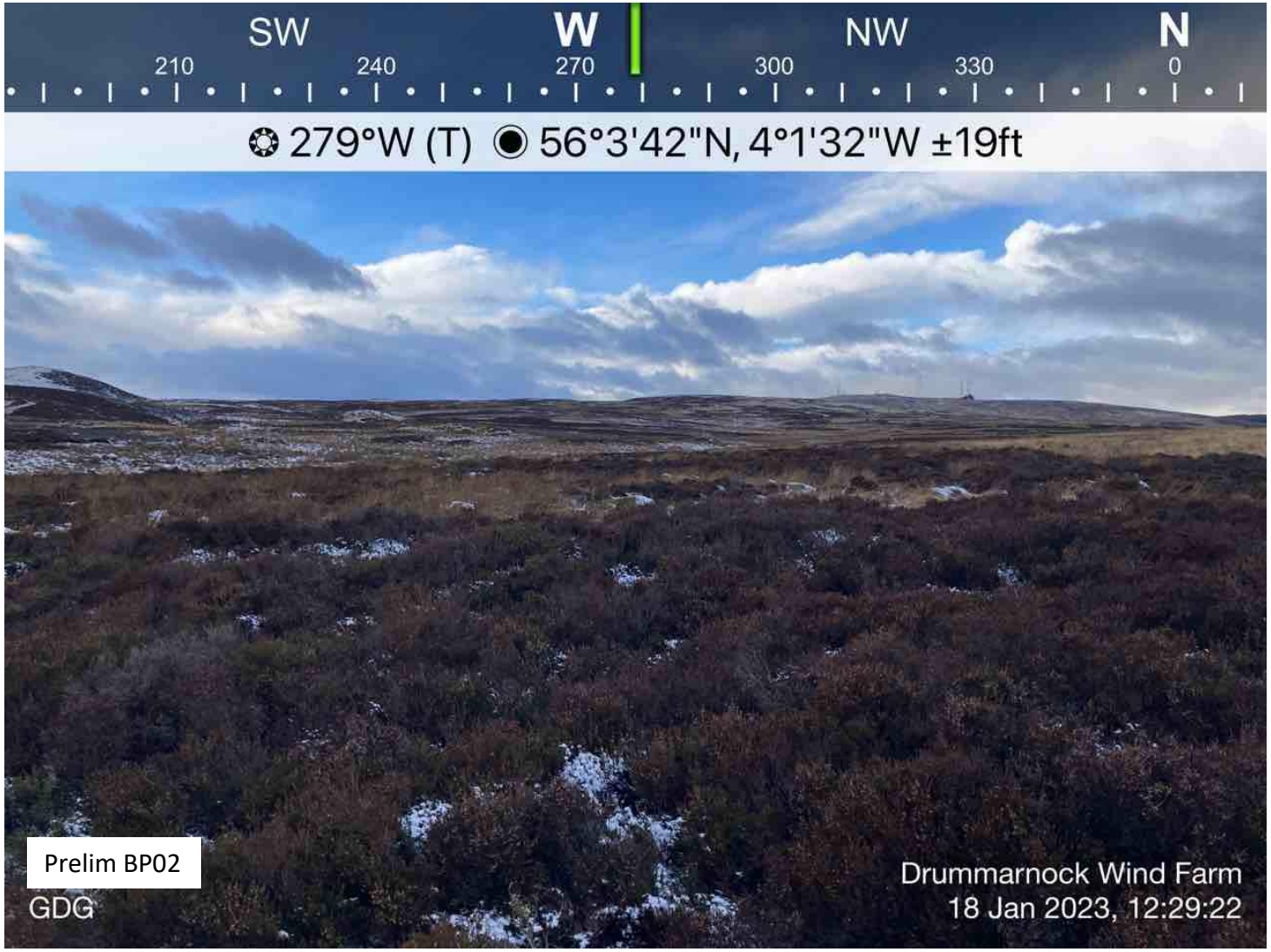


Photograph 6: View east from the western border across Prelim BP02



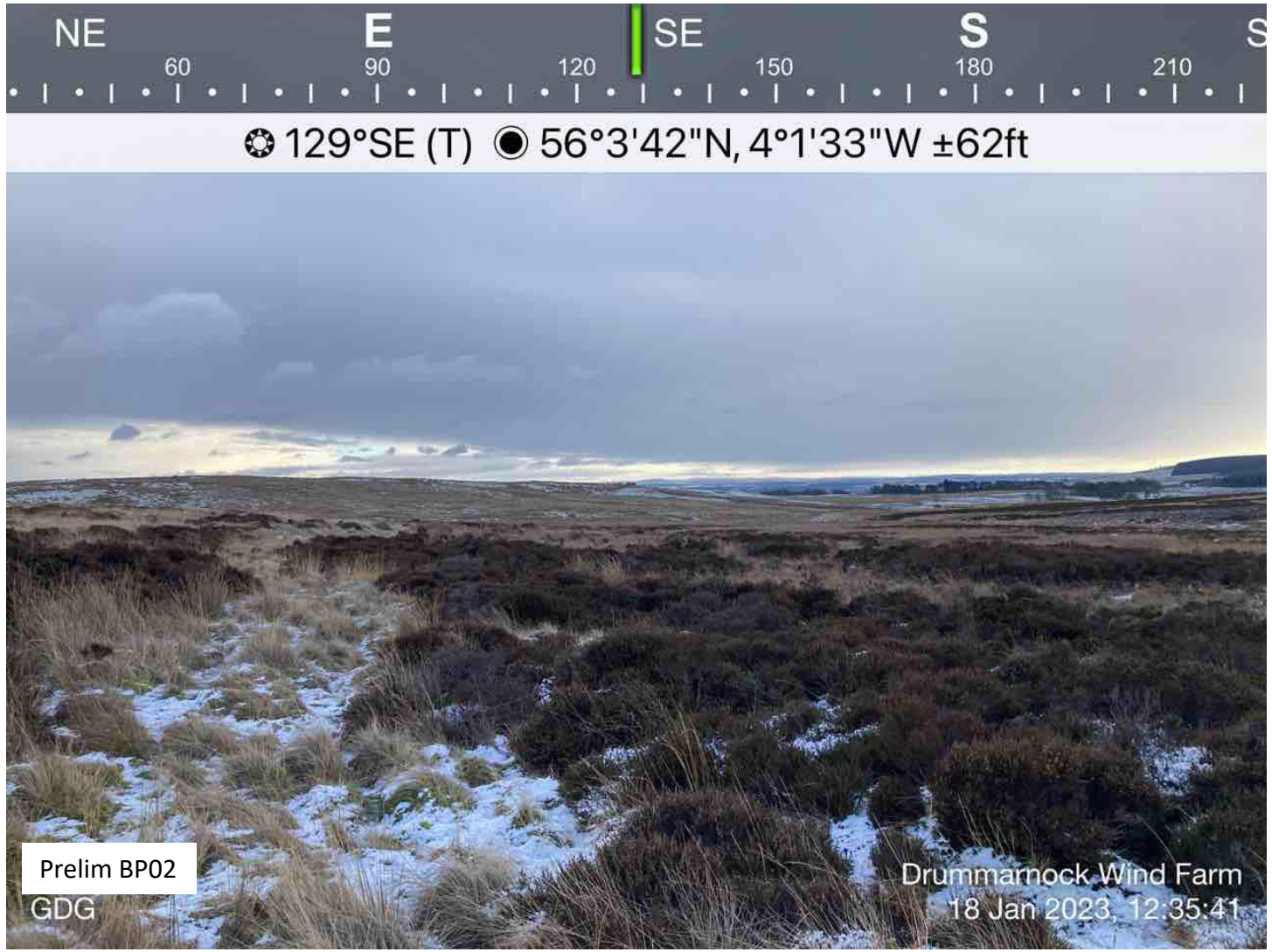
Photograph 7: View southwest along the eastern boundary of Prelim BP02

Photograph 8: View north of the western Prelim BP02 boundary.

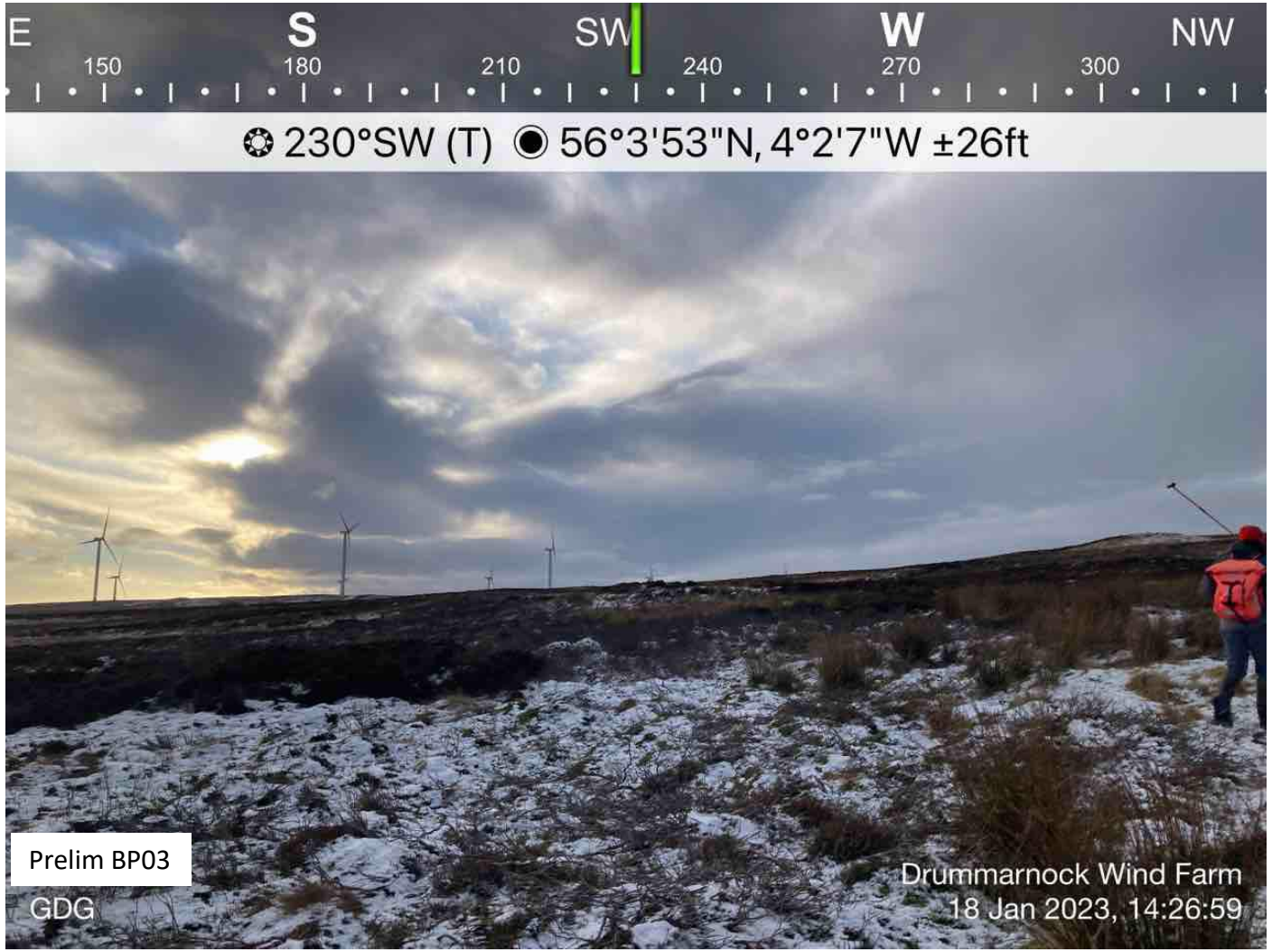


Photograph 9: Overview of Prelim BP02 looking west along the southwestern boundary.

Photograph 10: View west from the north eastern corner of Prelim BP02



Photograph 11: View southeast from the centre of Prelim BP02 area.



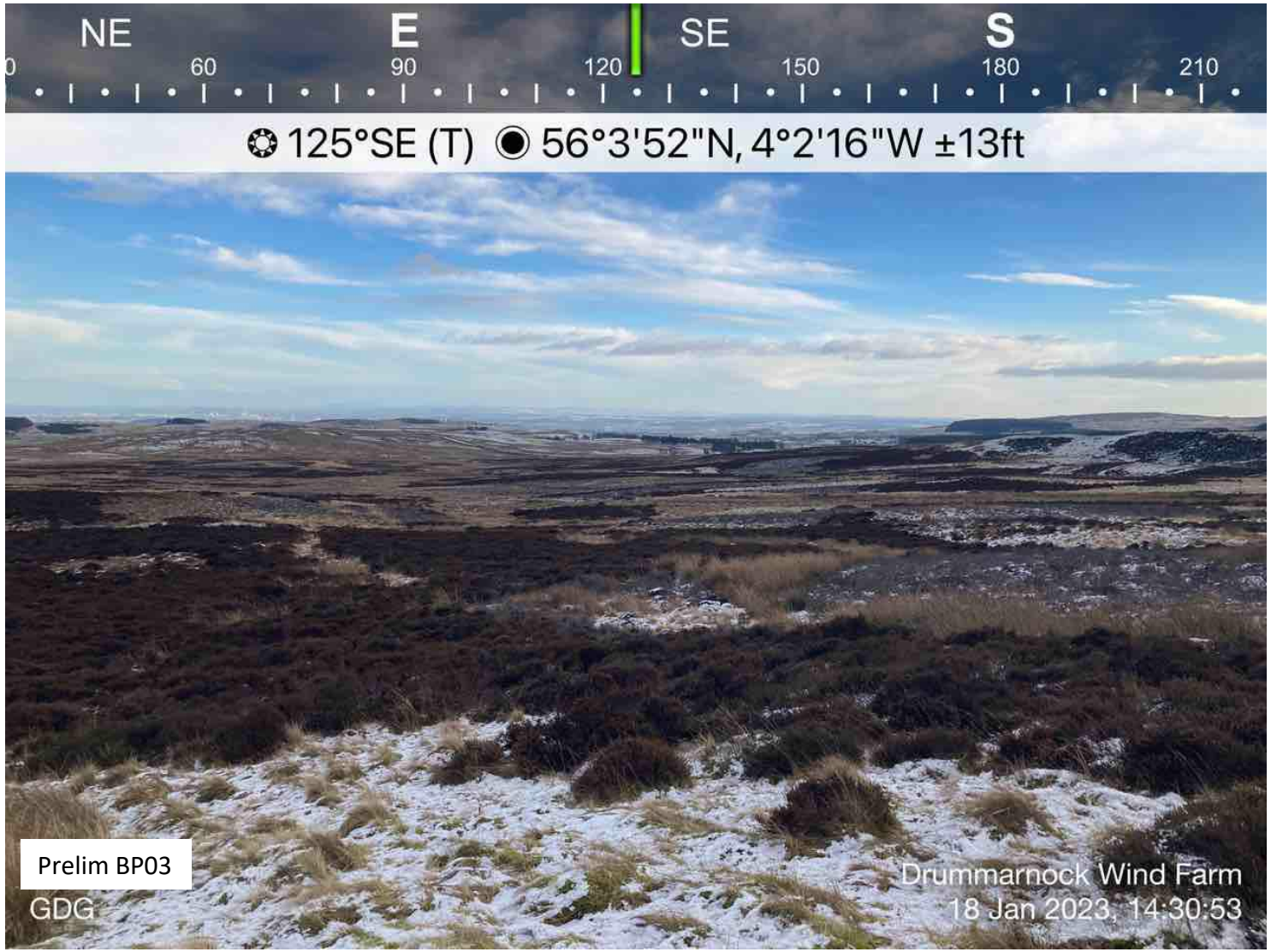
Photograph 12: View southwest from the eastern border of Prelim BP03.

BP03 – Photographs and Comments

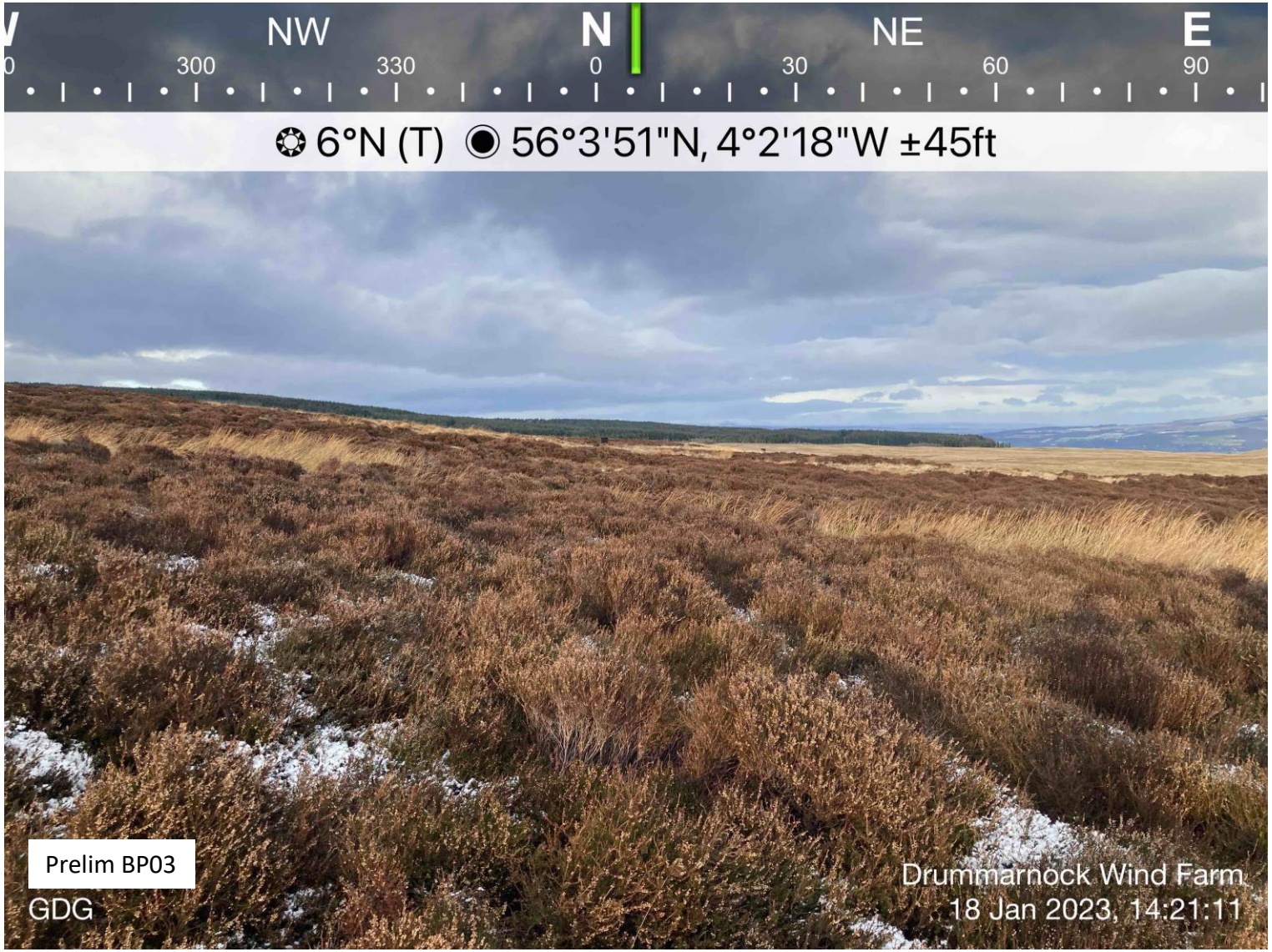
Photograph 13: View west upslope at a ridge in Prelim BP03.

Photograph 14: Rock outcrop exposed within Prelim BP03

Photograph 15: Weathered rock exposed in Prelim BP03.



Photograph 16: View southeast from the northern boundary of Prelim BP03.

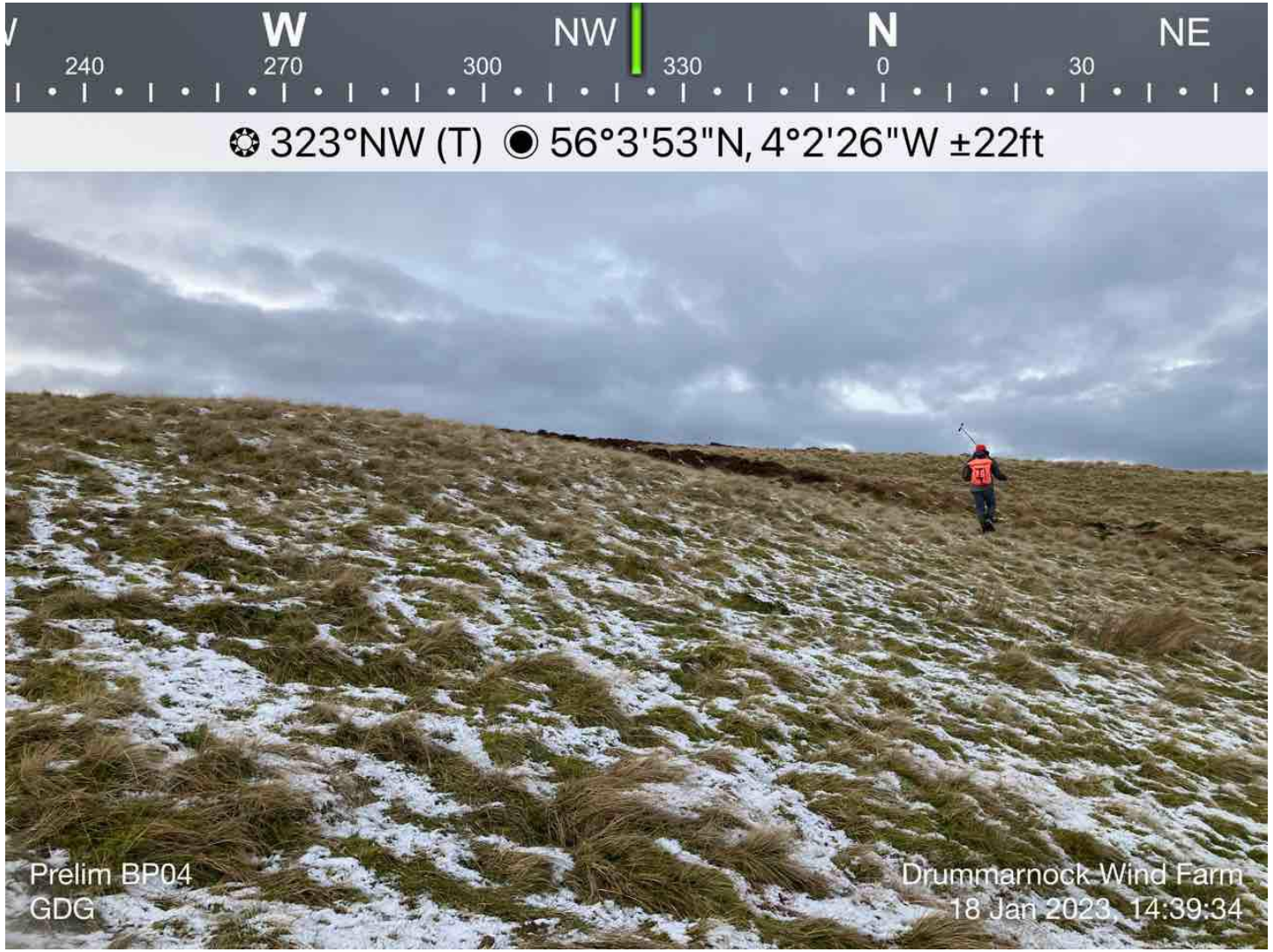


Photograph 17: View north within the area of Prelim BP03.

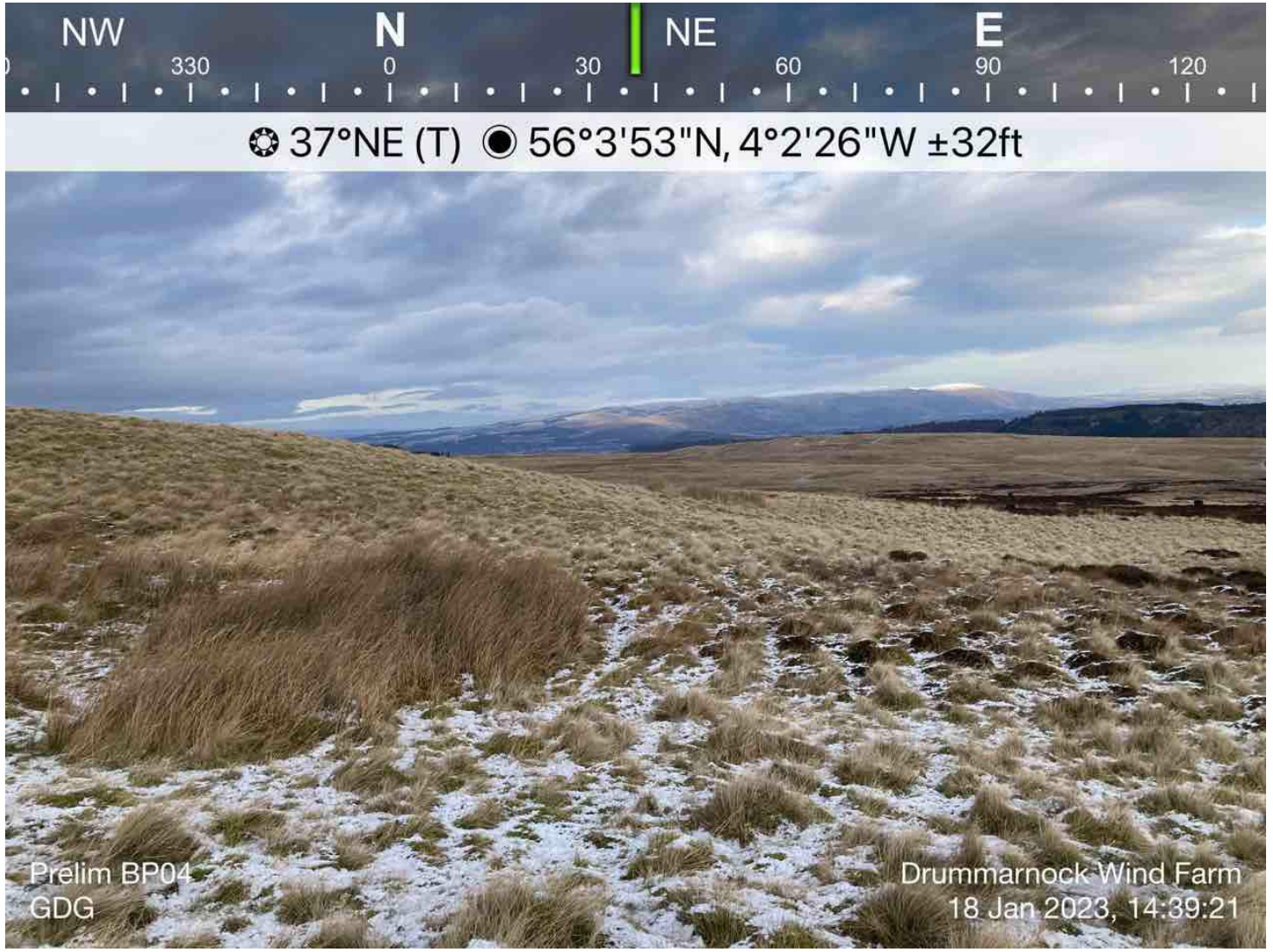
Photograph 18: View northwest from the southern boundary of Prelim BP03.

BP04 – Photographs and Comments

Photograph 19: View northwest from the south eastern corner of Prelim BP04, area overview.



Photograph 20: View from southwestern corner of Prelim BP04 northwest along the western boundary.



Photograph 21: View from the southwestern corner of Prelim BP04 northeast.

Photograph 22: View west upslope of Prelim BP04.

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