



Technical Appendix

Drummarnock Wind Farm

Technical Appendix 3-1: Borrow Bit Appraisal

Drummarnock Wind Farm Limited

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Drummarnock Wind Farm

Preliminary Borrow Pit Appraisal

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Table of Contents

1	Introduction	1
1.1	Brief	1
1.2	Scope of Report	2
2	Site Description	2
2.1	General	2
2.2	Geology	3
2.2.1	Superficial Geology	3
2.2.2	Solid Geology	4
3	Borrow Pit Locations	6
3.1	General	6
3.2	Criteria for Selection of Borrow Pit Search Area	8
3.3	Site Walkover	8
4	Conclusions and Recommendations	9
4.1	Conclusion	9
4.2	Recommendations	9
	Appendix A – Site Walkover Photographs	11

1 Introduction

1.1 Brief

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 National Grid Reference 275150, 687339. The site currently comprises a peat moorland.

The Proposed Development comprises the erection of 4 wind turbines and the construction of associated services and access infrastructure. Borrow pit(s) are proposed to provide aggregate for the construction of the site.

A site location for the development is provided in Figure 1-1.



Figure 1-1 Site Location and Boundary

1.2 Scope of Report

This Preliminary Borrow Pit Appraisal for the Proposed Development has been prepared to identify potential sources of rock within the development site required for the construction of the wind farm.

The following scope of work has been undertaken:

- Assess potential areas for extraction of stone
- Identify overlying superficial soils
- Identify underlying rock types

A walkover is to be undertaken on the basis of the findings of this preliminary desk-based study. At this stage, this assessment does not take into consideration peat stability; a Peat Landslide Hazard Risk Assessment can be found in Technical Appendix 8-2.

Site investigations will be necessary to ground truth the Desk Study and walkover findings.

The criteria in this desk study appraisal used to identify potential locations for Borrow Pits (BPs) have taken into consideration the topography, estimated rock quality, likely positions of rock outcrops, and the proximity to environmental and physical constraint areas provided by Atmos Consulting Ltd. The criteria adopted are further detailed in Section 3 of this report.

Rock volume estimates for construction are not available at this early stage, and therefore sizing of the borrow pits has not been undertaken. The layout of the borrow pits will evolve through the design process as intrusive investigation and projected rock requirements are finalised.

The quality and properties of the mapped rock at the proposed borrow pit location(s) have been assessed using the available literature and the typical characteristics of the rock present on site as no site investigation information is available.

Scottish Planning Policy (paragraph 243) states that *“Borrow pits should only be permitted if there are significant environmental or economic benefits compared to obtaining material from local quarries, they are time-limited; tied to a particular project and appropriate reclamation measures are in place”*. In relation to the Proposed Development, borrowing rock onsite would reduce the requirement of imported material, significantly reducing traffic on local roads during the construction phase.

2 Site Description

2.1 General

The site is that of a typical moorland, generally covered in heather and grass, in wetter areas merging into bog-land.

The topography across the site is largely undulating slopes down to the east, with rivers dissecting the slopes. The highest elevation on the site is found to be 373m AOD at the eastern boundary.

Based on aerial imagery the site is largely moorland with grazing for sheep, with a few dwellings including a working farm and associated infrastructure in the east of the site.

2.2 Geology

2.2.1 Superficial Geology

Superficial soils are recorded by the BGS, shown in Figure 2-1 to be comprised of hummocky glacial mounds protruding through peat, likely underlain by glacial till in the west of the site. Glacial till dominates the eastern portion of the site, along with alluvium alongside the streams on site. In some areas on site (Figure 2-1) there are no superficial deposits recorded, which may imply bedrock is near or at the surface.

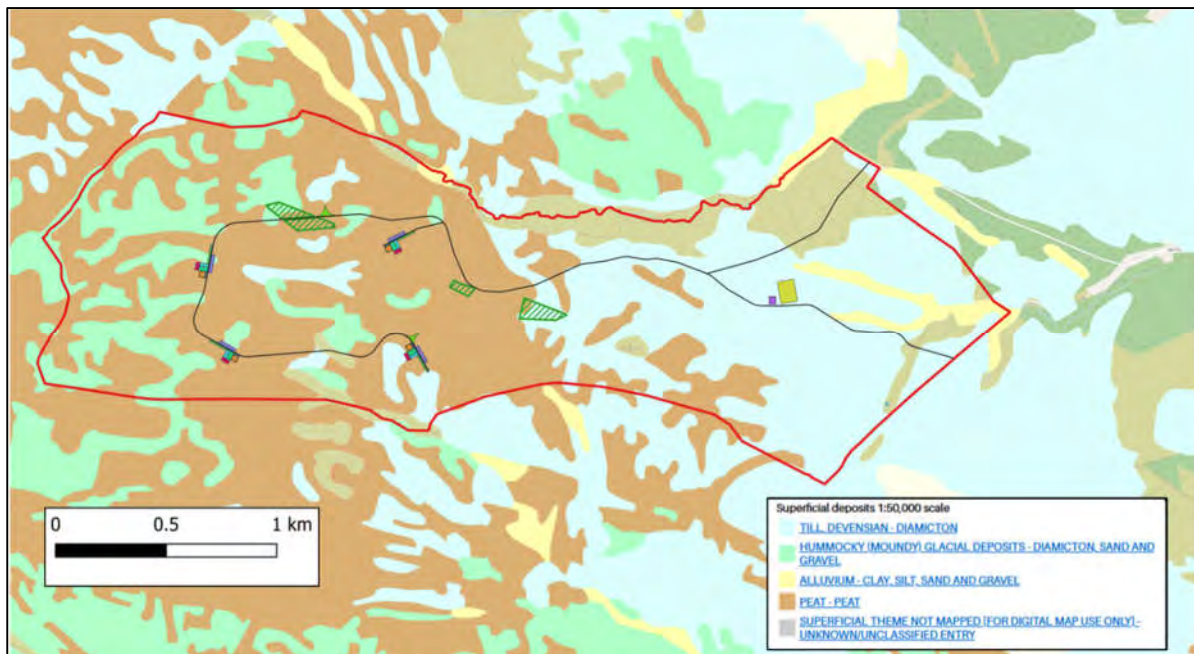


Figure 2-1 Superficial Geology (1:50,000 Maps- BGS 2022)

Peat probing has been undertaken (by Atmos Consulting). Interpolated peat depths for the area of the site presently surveyed provided by Atmos are shown in Figure 2-2. At present, there is not an obvious pattern of the peat depth thickness across the site, although in a few areas where the topography is flatter the peat depth thickness appears to be elevated.

The 1:1M Superficial Engineering Geology dataset provided by BGS provides information on the engineering properties of the superficial deposits.

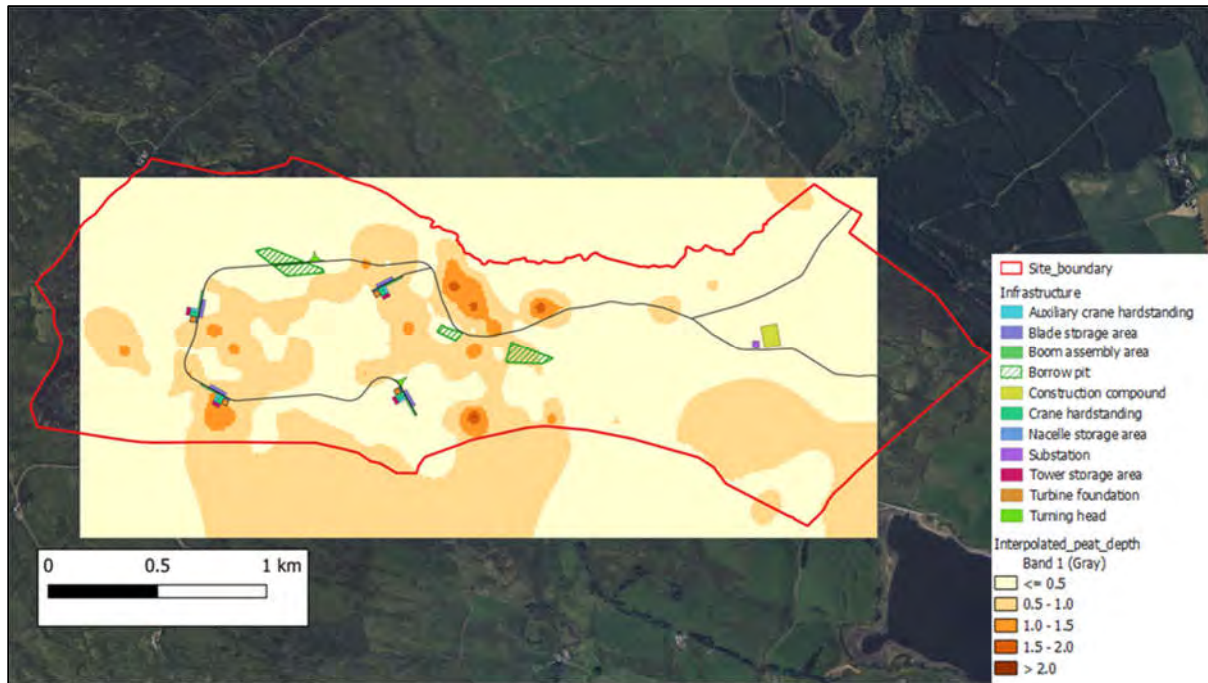


Figure 2-2 Interpolated Peat Depths (Atmos Consulting)

The properties of the cohesive till (firm to very stiff or hard slightly gravelly sandy clay with few cobbles and boulders) will cause excavations to be stable in the short term, but the water-bearing layers/lenses of silt, sand and gravel and the presence of fissures can significantly decrease stability. A proportion of the glacial till deposits may likely be suitable as a cohesive general engineered fill (depending on grading and plasticity). The proportions of suitable material are dependent upon the moisture content and a large proportion of shallower weathered deposits may likely be wet of optimum and require improvement to be rendered suitable. The proportion of acceptable material is likely to increase with depth.

The 1:1M Superficial Engineering Geology records note that the alluvial soils (very soft to very stiff sometimes clay or silt) present locally on the site are easy to dig. Excavations usually require immediate support, but localised stiff clays may be stable in the short term where groundwater ingress is controlled or absent. Alluvial clay soils are unlikely to be suitable as general cohesive fill due to their likely elevated moisture content and potentially elevated organic content.

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.

Investigation and testing would be required to verify the above assumptions.

2.2.2 Solid Geology

A review of the British Geological Survey found the bedrock underlying the site comprises the following geological units outlined in Table 2-1 and shown in Figure 2-3. The two main geological units

beneath the site comprise basaltic and gabbroic rock, both of which are likely to produce an adequate material for general fill purposes, as the BGS classify as both rock types as typically very strong.

Table 2-1: Geological units present underlying the site

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

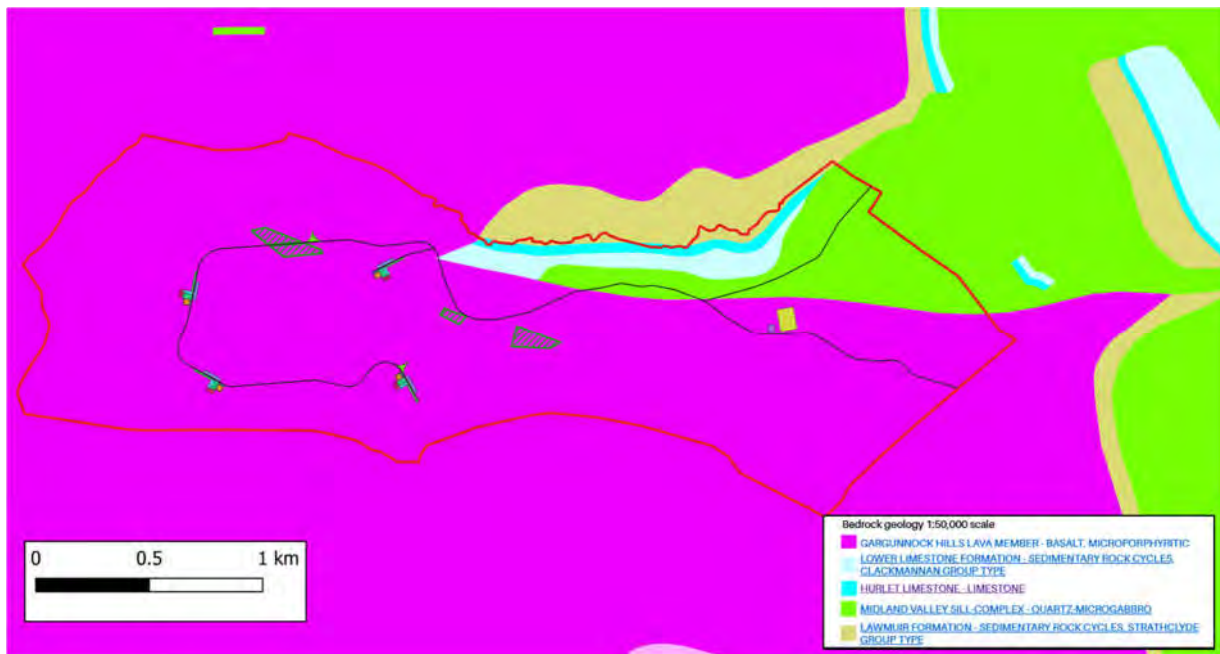


Figure 2-3 Bedrock Geology (1:50,000 Maps- BGS 2022)

The BGS state the basaltic and gabbroic rock may be excavated by hard digging or ripping in some areas, but blasting would usually be required for fresher material, depending on spacing and orientation of discontinuities.

The 1.1M engineering geology dataset by the BGS classifies the geological units for their suitability as engineering fill. It states for the basaltic rock, would be suitable as a selected granular fill if care is taken in selection and abstraction. However, some basalts may exfoliate to a slight extent after long periods of weathering. For the gabbroic rock fresh rock, it states it would be suitable as a selected granular fill.

The BGS recommend that during site investigation it is important to determine the intact rock strength, spacing, orientation and nature of discontinuities (including water flows) and nature/depth

of the weathered zone material. Specifically for the basaltic rock, the BGS emphasise the need to determine the possible presence of tuff layers and paleosols (fossilised soils beneath volcanic flows).

Investigation and testing would be required to verify the above assumptions. The depth to the rockhead to exploit any suitable rock will be a key consideration.

3 Borrow Pit Locations

3.1 General

Four potential areas have been identified as locations for borrow pits (BP01-BP04). The location of each borrow pit area is identified within Figure 3-1. Each area was selected based on the pre-determined criteria provided by Atmos Consulting Ltd, outlined in Section 3.2.

No site investigation of soils or bedrock has been carried out to date. Site investigations are required to assess the extent of the geological unit and the soil and rock characteristics. Additionally, findings from the investigation would determine if the rock available on site would be suitable for use as a concrete aggregate.

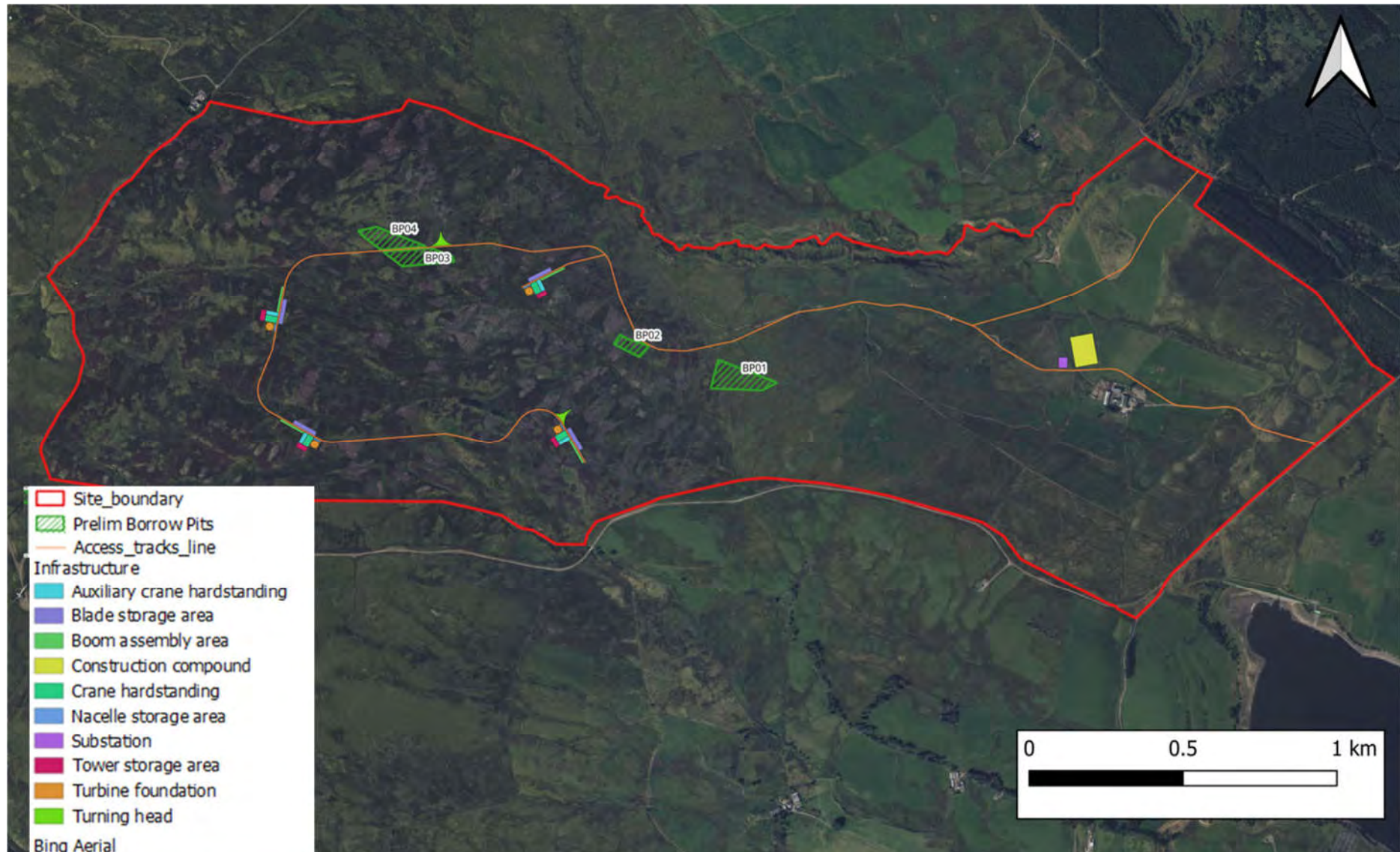


Figure 3-1 Preliminary Borrow Pit Location Areas

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. A selection of representative photographs with associated comments is provided in Appendix A.

The walkover was undertaken to ascertain the ground conditions at each of the preliminary BP areas, the findings are summarised below in Table 3-1.

Across the whole site and within the preliminary borrow pit locations identified in this report, outcrops of rock were very limited. The site was primarily covered in heather on slopes and grasses in the flat-lying boggy areas.

Where rock was exposed, it was difficult to identify the lithology as across the site it was highly weathered or covered in lichen-like vegetation. Most frequently when exposed rock was observed it coincided with appeared shallower peat depths.

Based on the walkover, the areas that were found to be steeper would be more suited for borrowing stone, i.e. BP03 and BP04, although no constraints were observed on site that would limit the other areas for extraction.

4 Conclusions and Recommendations

4.1 Conclusion

The purpose of this Preliminary Borrow Pit Appraisal was to assess potential locations for borrow pits, the temporary extraction of rock at the Proposed Wind Farm Development near Drummarnock, Stirlingshire.

A review of the data sets detailed within this report combined with observations from site walkover has identified four potential locations across the site for a borrow pit.

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.

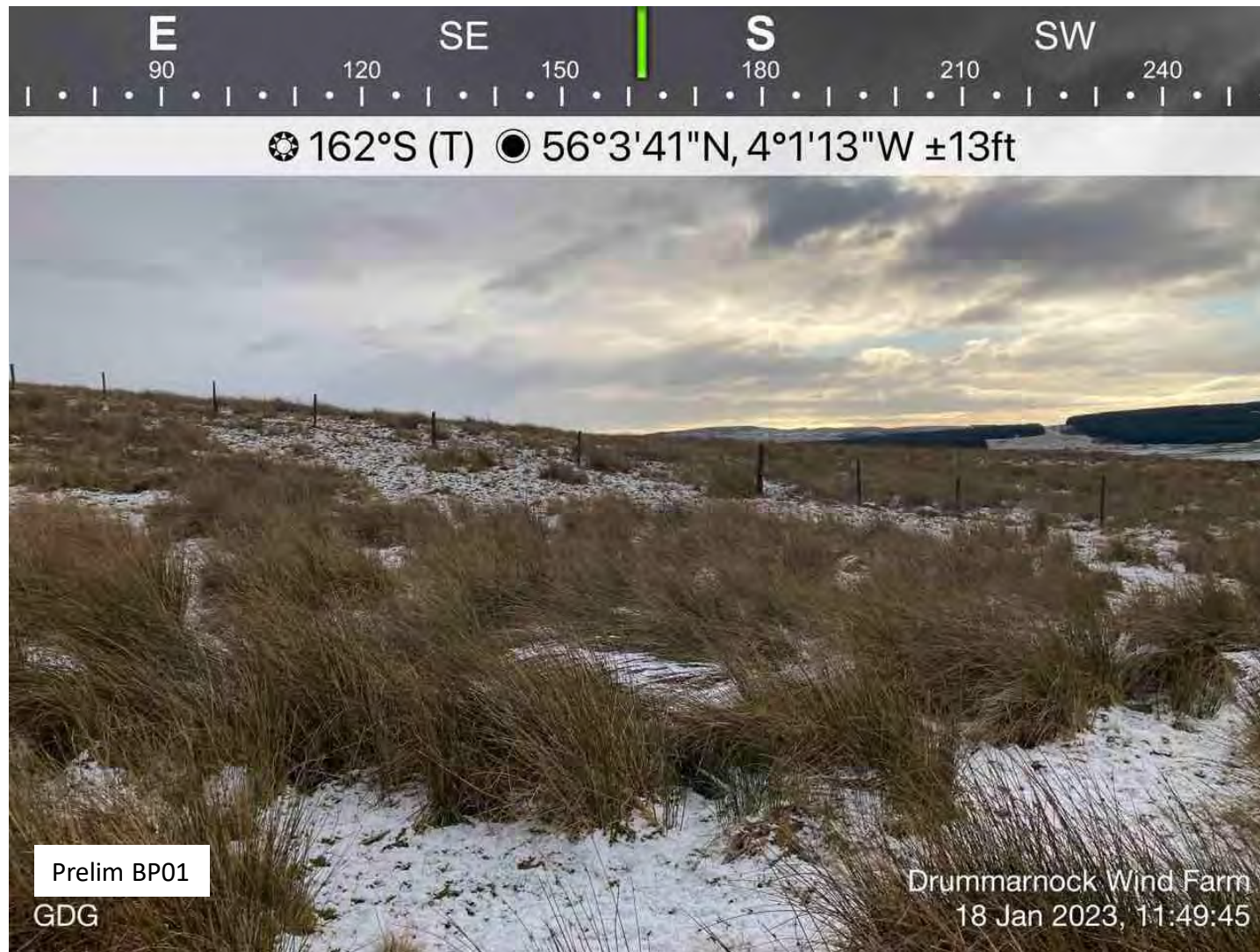
Table 4-1 Preliminary Borrow Pit Area Descriptions

Preliminary Borrow Pit ID	Photograph Reference Number (Appendix A)	Location Description
BP01	1 – 4	The area of preliminary BP01 was observed to dip gently to the southwest and level out to the west where the low-lying area became a saturated bog. In this preliminary location there were no rock outcrops observed. Vegetation was dense was mostly long grasses and sparse pockets of heather.
BP02	5 – 11	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	12 – 18	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.

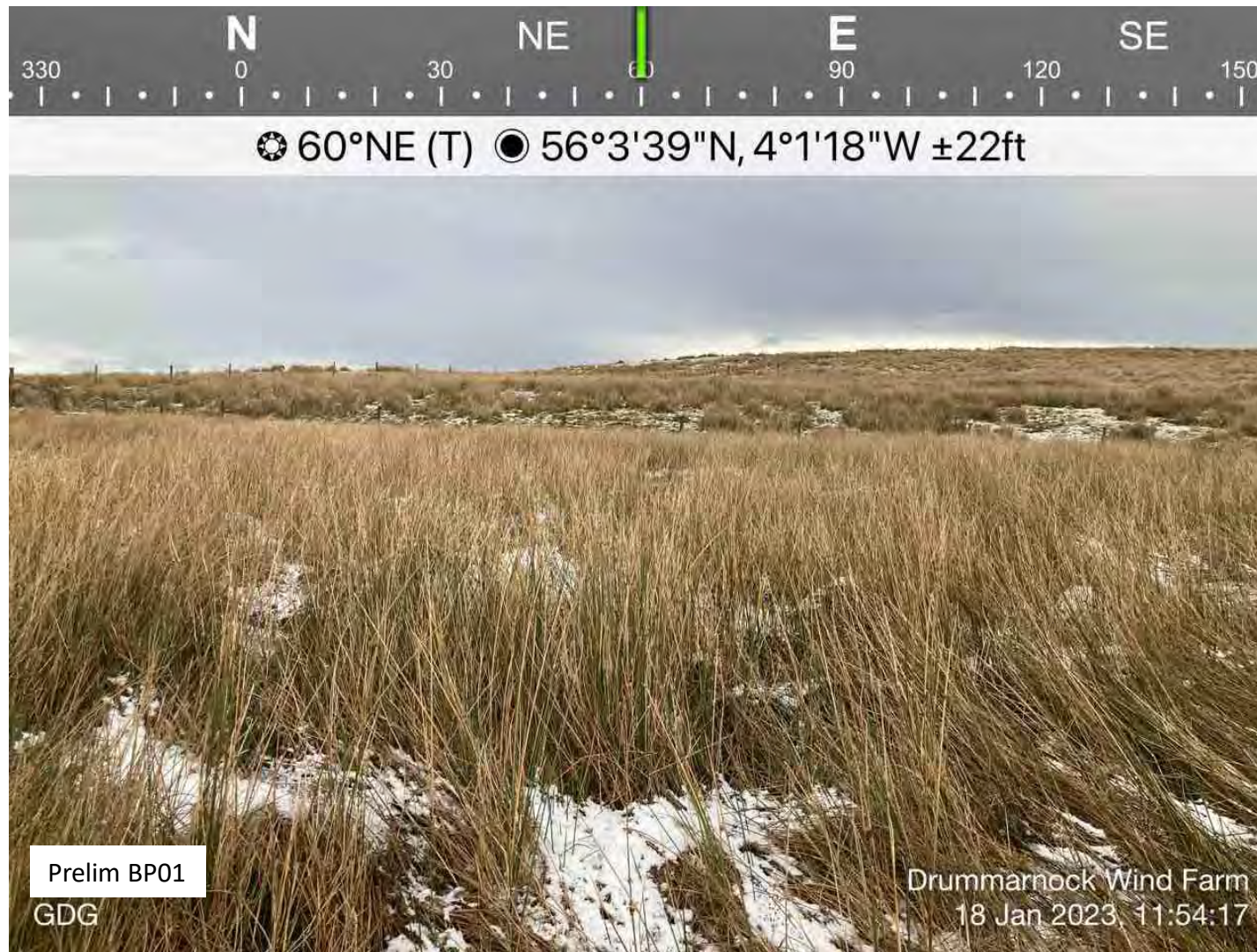
Appendix A – Site Walkover Photographs



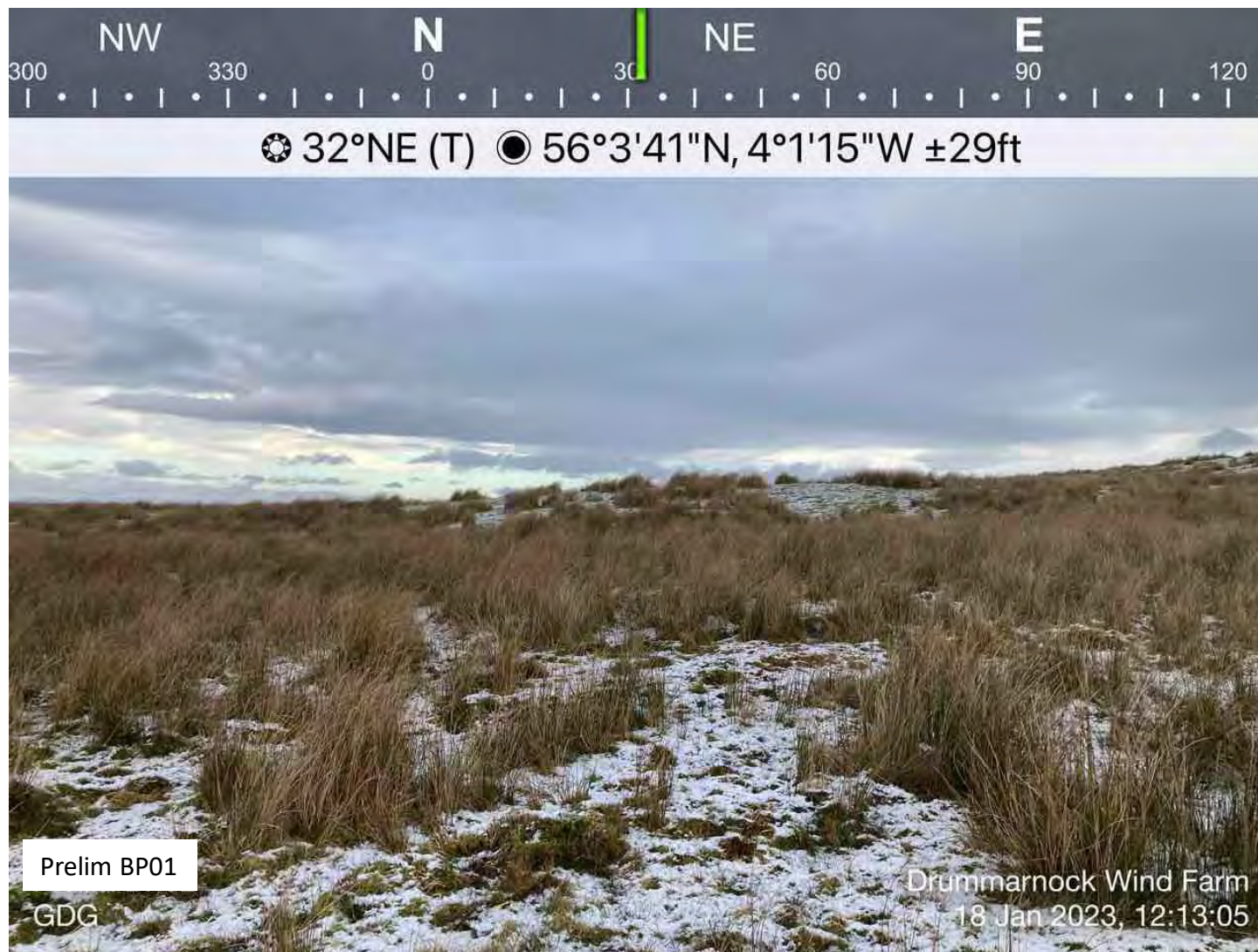
Photograph 1: View from the eastern boundary across Prelim BP01, looking downslope.



Photograph 2: View south from the northern boundary across the Prelim BP01.



Photograph 3: View from the southwestern corner of Prelim BP01. Looking up-slope from the flat-lying marsh area.



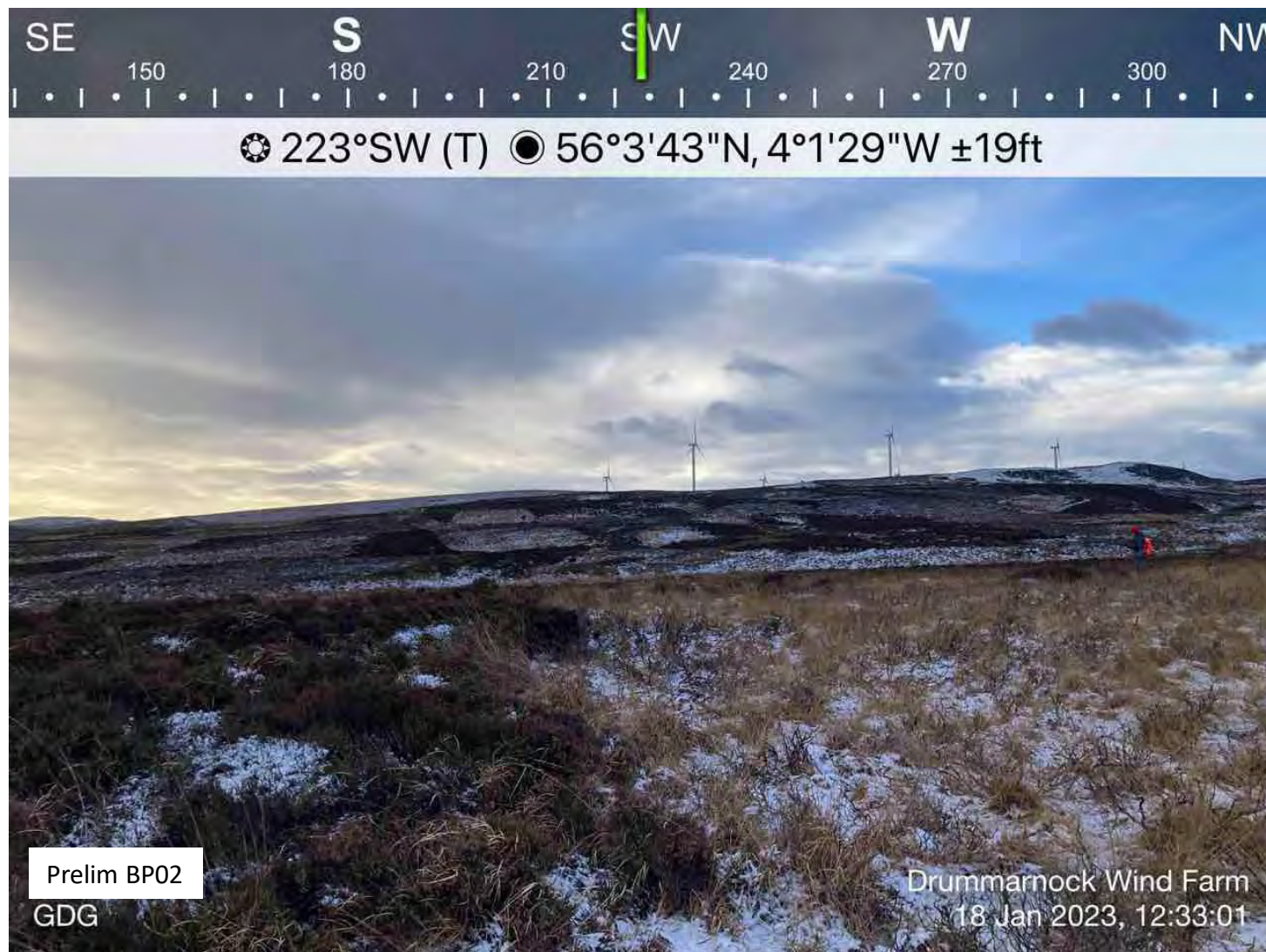
Photograph 4: View looking northeast up slope from the southern boundary of Prelim BP01.



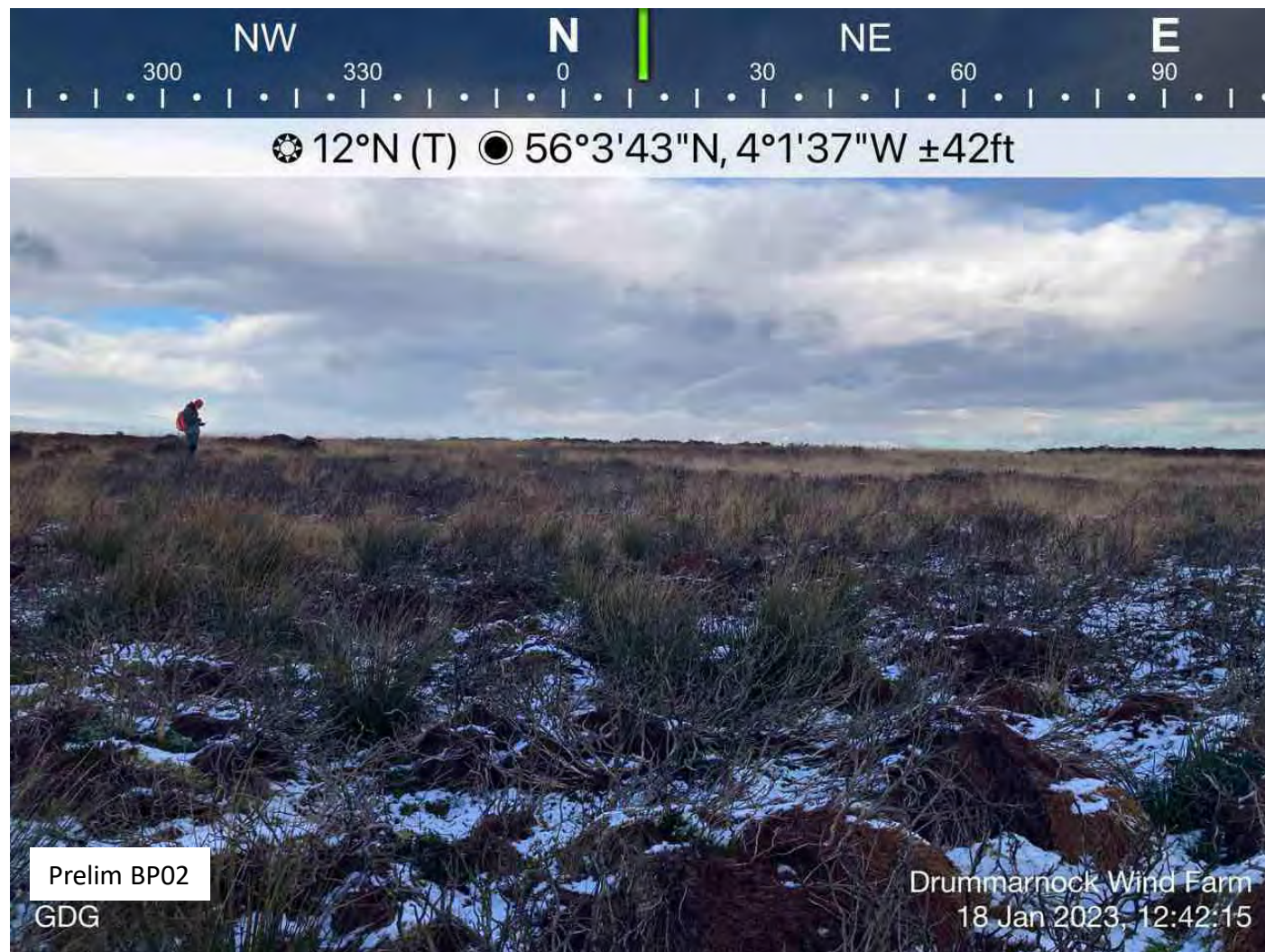
Photograph 5: View east along the northern boundary of Prelim BP02



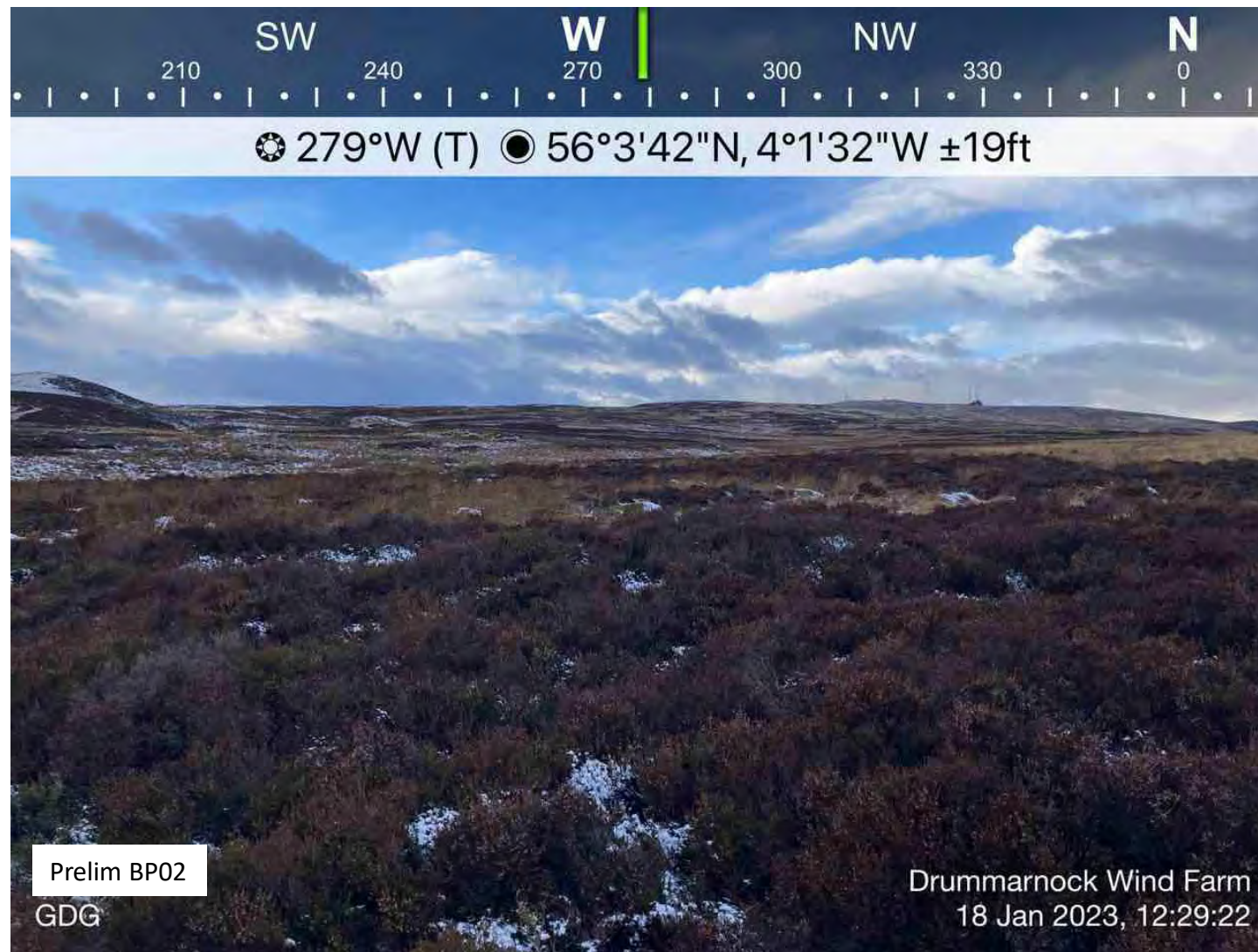
Photograph 6: View east from the western border across Prelim BP02



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



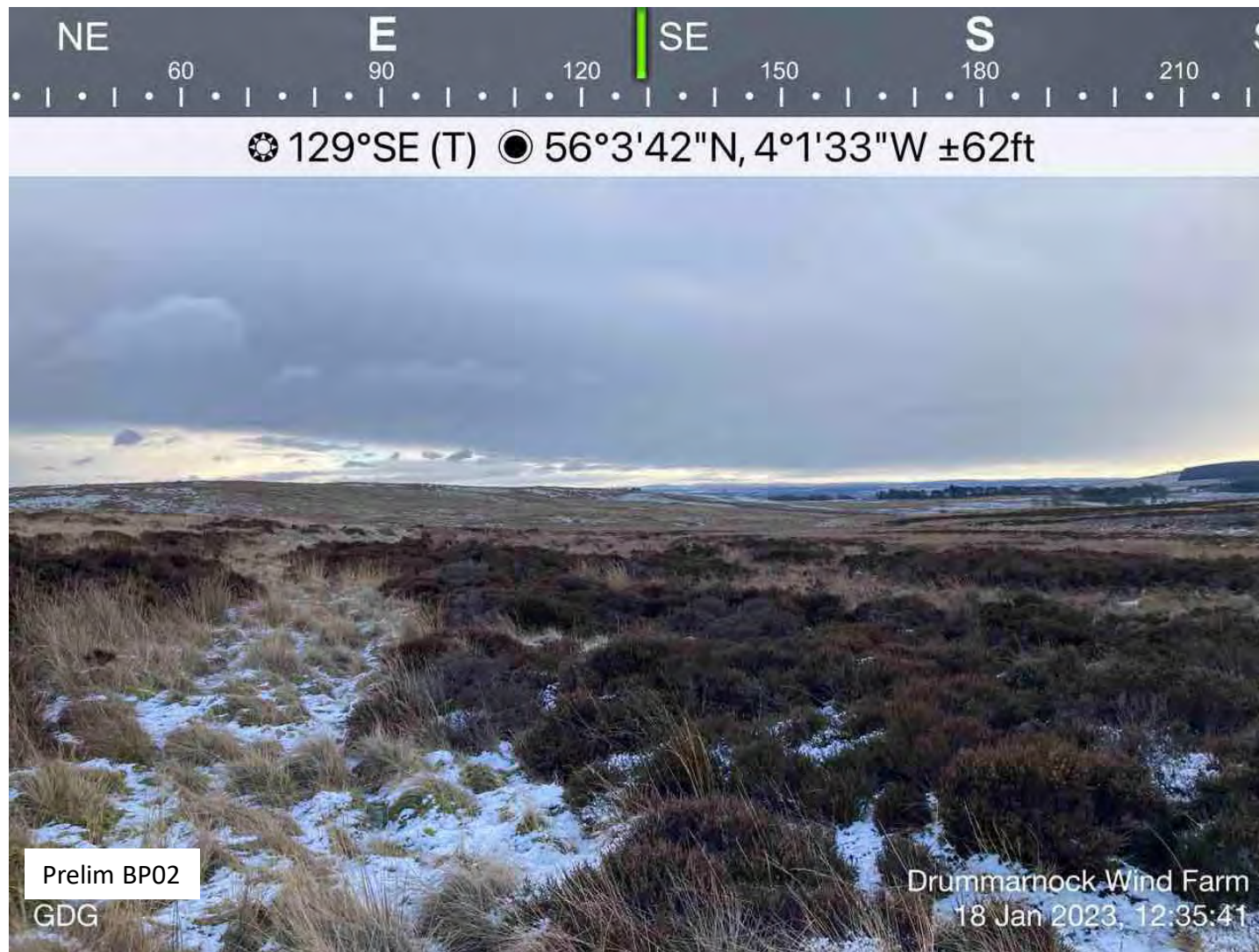
Photograph 8: View north of the western Prelim BP02 boundary.



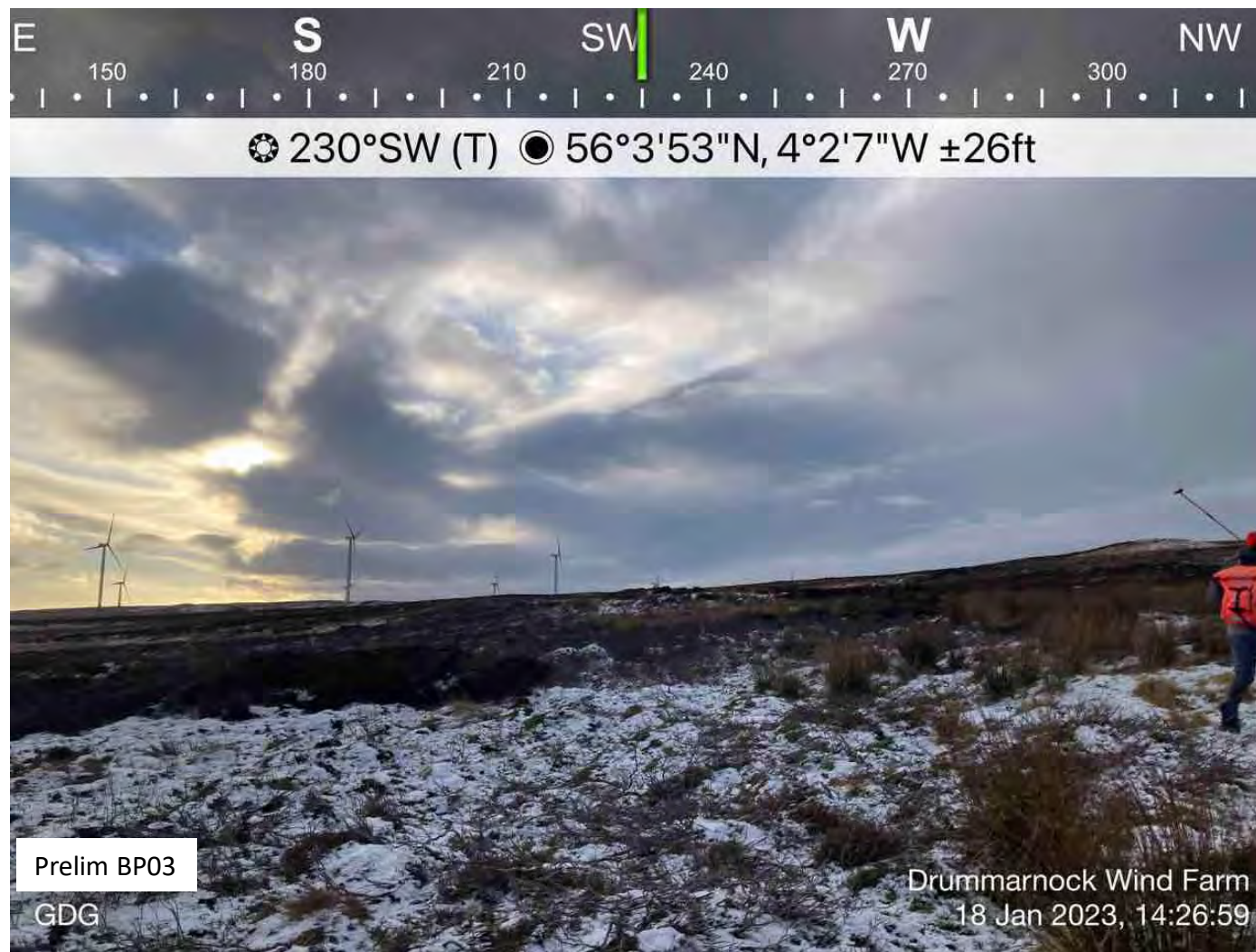
Photograph 9: Overview of Prelim BP02 looking west along the southwestern boundary.



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.



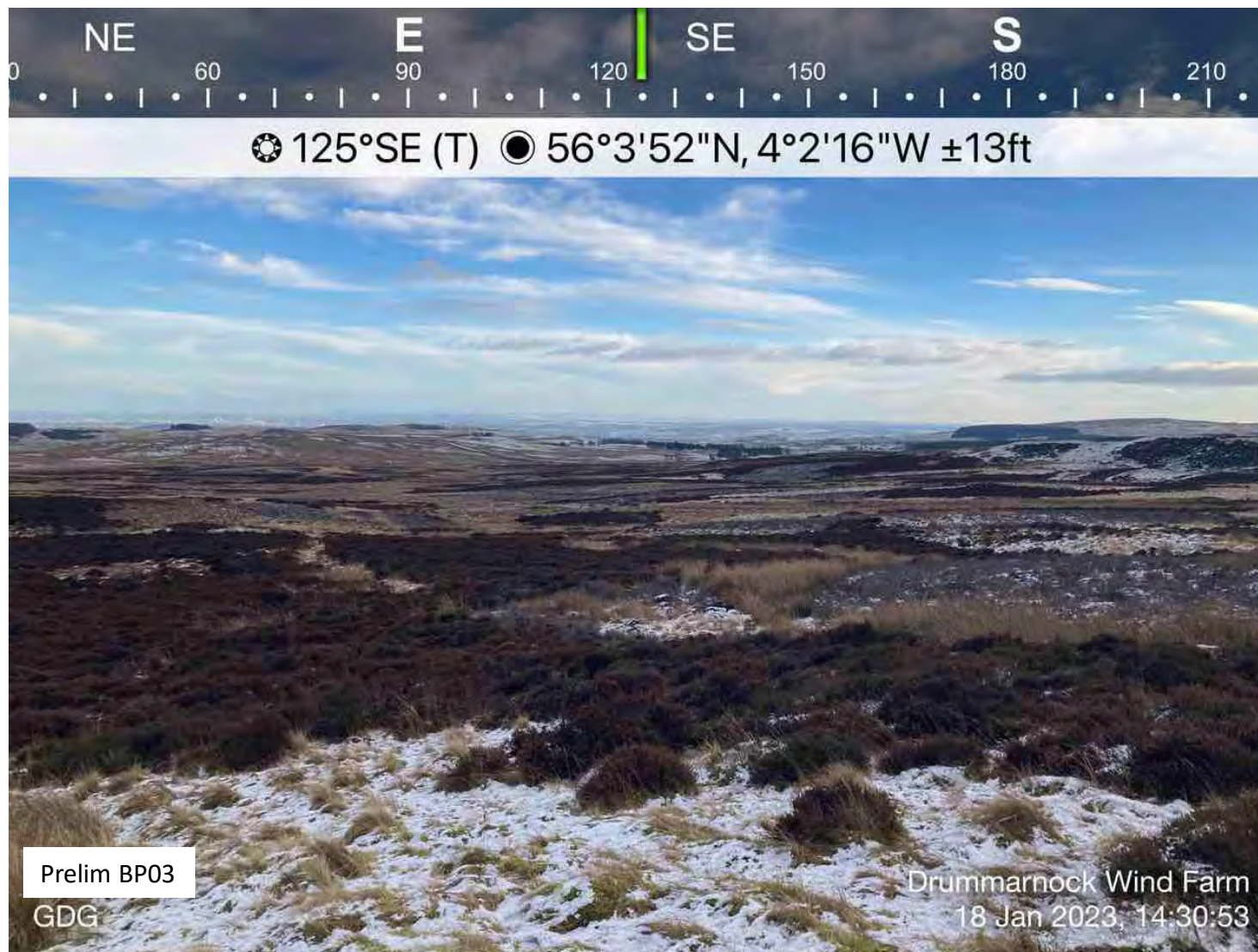
Photograph 13: View west upslope at a ridge in Prelim BP03.



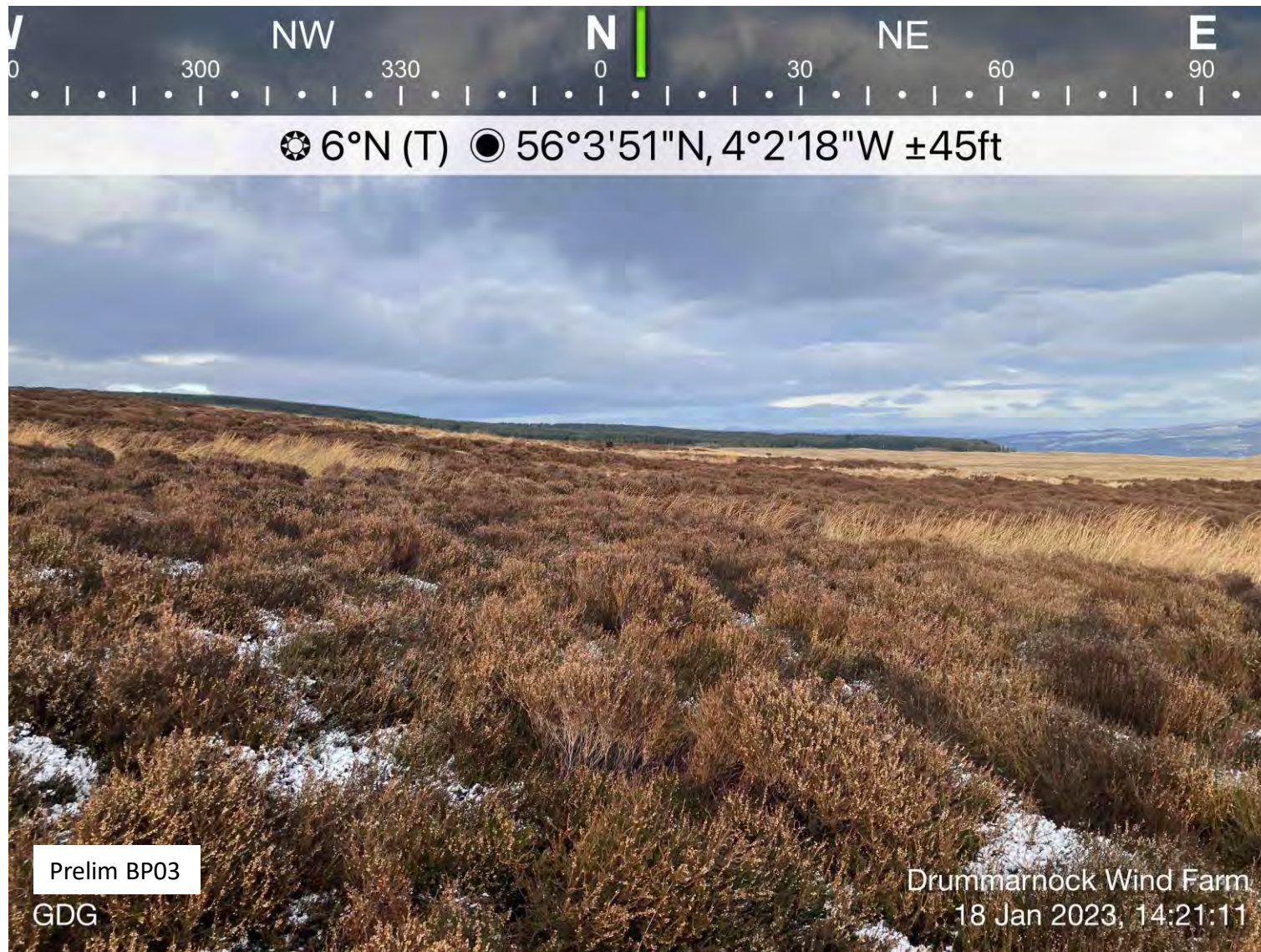
Photograph 14: Rock outcrop exposed within Prelim BP03



Photograph 15: Weathered rock exposed in Prelim BP03.



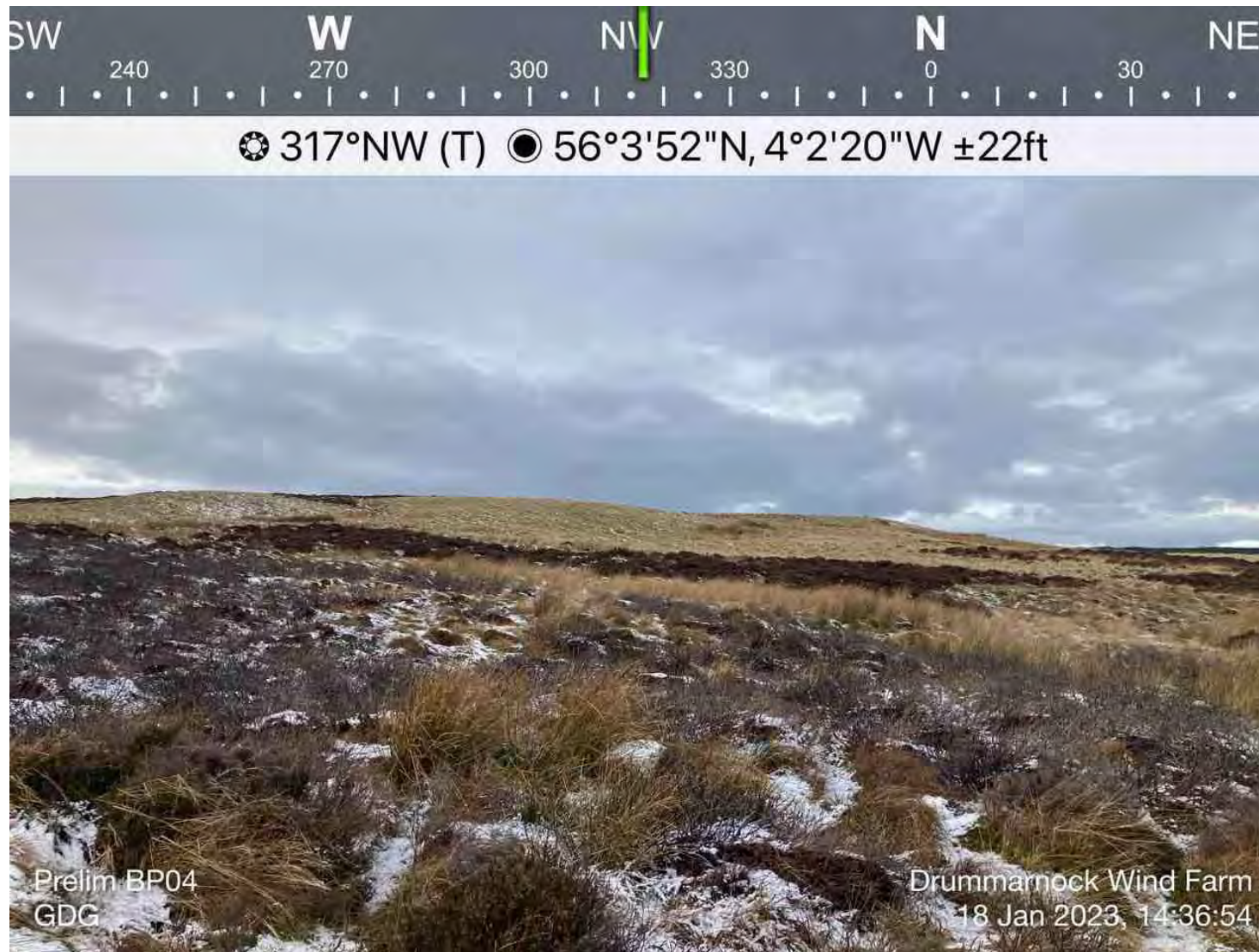
Photograph 16: View southeast from the northern boundary of Prelim BP03.



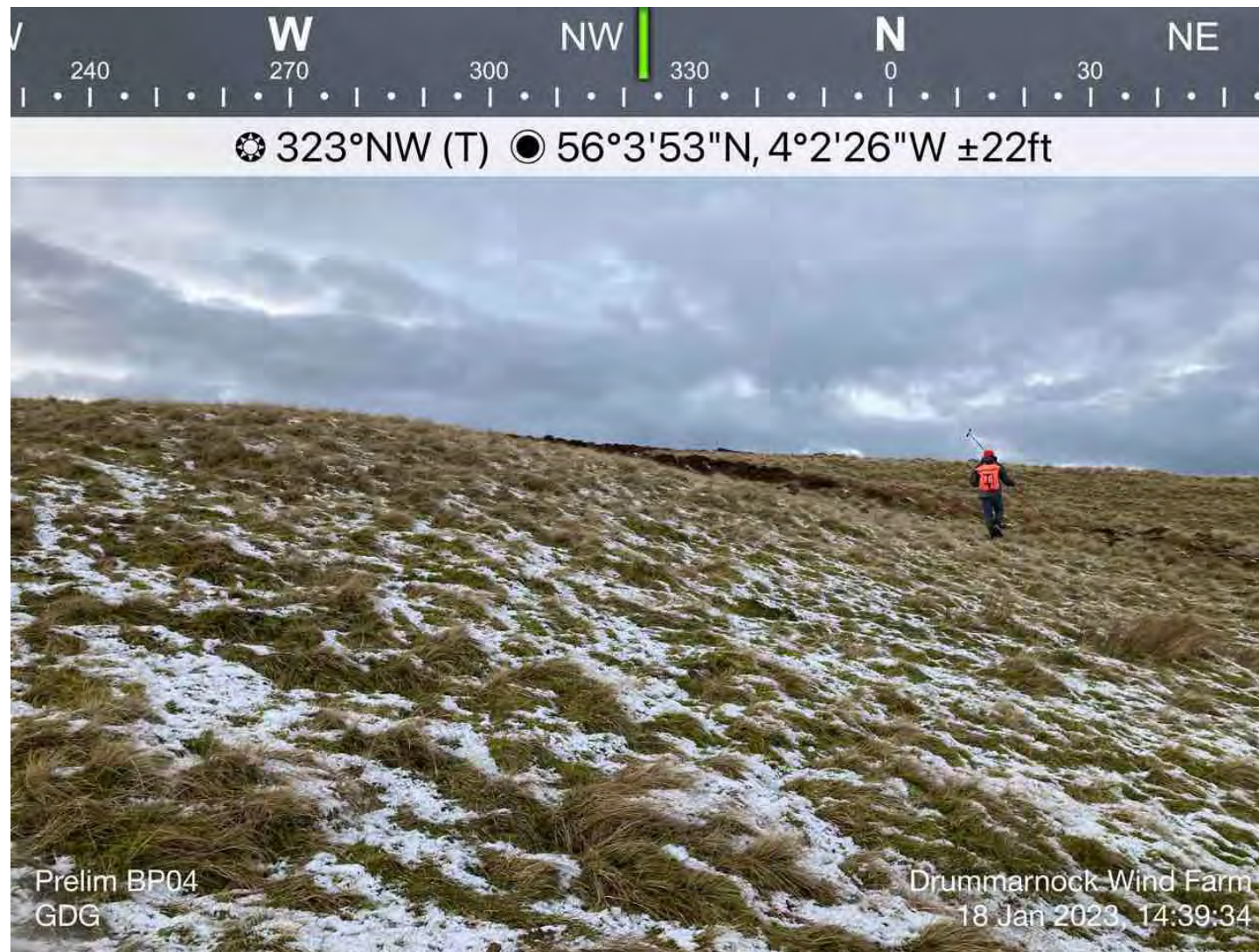
Photograph 17: View north within the area of Prelim BP03.



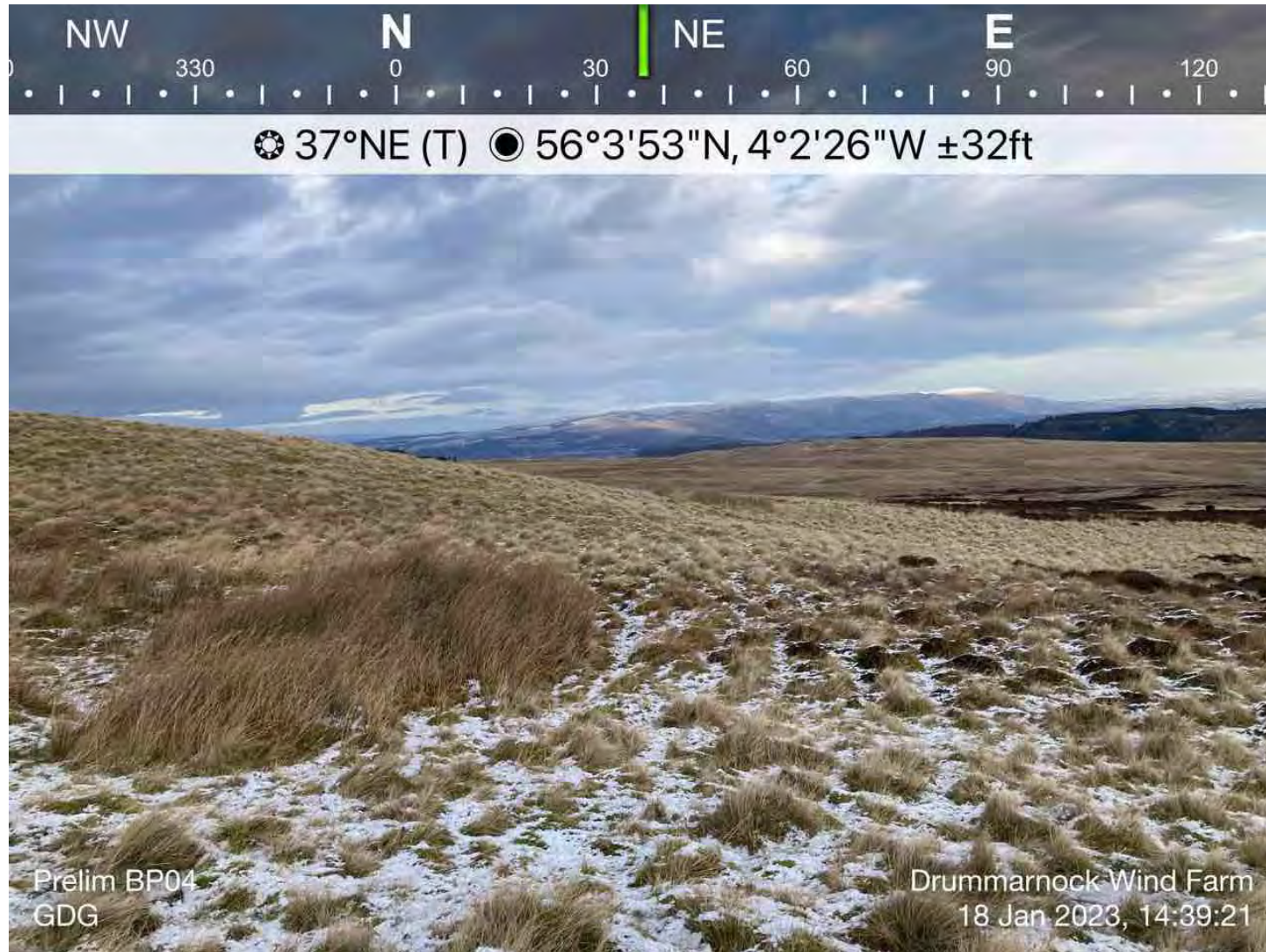
Photograph 18: View northwest from the southern boundary of Prelim BP03.



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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