



Technical Appraisal 10.5: Borrow Pit Appraisal

Aultmore Wind Farm Redesign

Vattenfall Wind Power Ltd.

Prepared by:

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1.0 Introduction

1.1 General

SLR Consulting Ltd (SLR) was commissioned by Vattenfall Wind Power Ltd (The Applicant) to undertake a Borrow Pit Appraisal (BPA) at the proposed Aultmore Wind Farm Redesign ('the proposed development').

It is anticipated that the development would comprise of up to 16 wind turbines with associated infrastructure including new and upgraded access tracks, crane hardstandings, borrow pits, substation and temporary construction compounds. The site layout is detailed on **Figure 10.5.1** and further details can be found in **Chapter 2: Proposed Development Description** of the EIA Report.

This report provides details of the proposed borrow pits, which would be necessary to provide the aggregates required to construct the proposed development.

The work has been undertaken by a team of Geotechnical Engineers and Geologists, with over 10 years' experience in undertaking peat assessments. The team was led by a Chartered Hydrogeologist with 30 years' consultancy experience and specialising in the assessment of soils, geology and water for renewable power projects in Scotland.

1.2 Scope and Objectives of the Report

There has been substantial works undertaken to date at the proposed development to inform the proposed borrow pits, including site reconnaissance visits and several phases of peat probing which are detailed within **Technical Appendix 10.1: Peat Landslide and Hazard Risk Assessment (PLHRA)** and **Technical Appendix 10.2: Peat Management Plan**.

The principal objective of this report is to provide an initial assessment of the aggregate requirements for the proposed development and identify potential borrow pits suitable for providing this aggregate.

There are four proposed borrow pit search areas reviewed within this report. Selected because of their morphology, accessibility from proposed tracks, orientation and the expected proximity to suitable rock close to the surface. The proposed borrow pits are in areas where peat coverage is anticipated to be minimal and where bedrock may outcrop and potential aggregate reserves are expected to occur near the surface.



2.0 Geological Setting

2.1 Superficial Geology

BGS mapping indicates that peat and glacial till are the most common superficial deposits within the proposed development. Till (Devensian) is present throughout the majority of the site. Localised peat deposits are present throughout the site, predominantly in the east, southeast, southwest and areas of the north. Alluvium is located adjacent to watercourses in the south and east of the site. Areas of the north and west of the south are absent from mapped superficial deposits which may be indicative of shallow or exposed bedrock.

Figure 10.5.2 contained within this report details the superficial geology BGS mapping overlaid across the proposed development.

2.2 Bedrock Geology

BGS mapping indicates that the Findlater Flag Formation (Neoproterozoic) is underlying the proposed development. This unit is predominantly comprised of metamorphic rocks, psammite and semipelite. Quartzite units in this formation are present in areas of the north, east and south of the proposed development.

Figure 10.5.3 contained within this report details the bedrock geology BGS mapping overlaid across the Proposed Development.

2.3 Mining and Quarrying

The BGS Geindex indicates that there are 19 pits and quarries within the proposed development area, predominantly in the west, east and northeast. Many of these are worked out, historic sites, but others are still used by FLS for aggregate for track creation and maintenance.

In the west of the site, quarries and pits such as Little Millstone Hill, Tor Sliasg Quarry, Tarrymount Quarry, and Park of Raffin Quarry are present.

In the eastern area of the proposed development, Old Fir Hill Gravel Pits, Hill of Clashmadin Gravel Pits and Blackhillock Quarry are present.

There is an extensive network of existing forestry tracks on site which are likely sourced from the existing site quarries.

2.4 Aerial Photography

The OS mapping and aerial photography do not indicate exposed bedrock. This is also confirmed by the site visit where exposed bedrock was recorded to be limited.



3.0 Borrow Pit Assessment

This section of the report provides an assessment of the potential borrow pit locations with an evaluation of their potential to meet the proposed development's aggregate requirements.

The assessment has been completed through a desk-based review of geological maps and memoirs and is supported by several site visits from SLR geologists and a geotechnical engineer. Potential borrow pit locations were inspected visually with a view to assessing ground conditions and to help determine the borrow pit's suitability for use during construction of the proposed development.

In exploring the four potential borrow pit locations, as defined on **Figure 10.5.1**, consideration has been given to the practical aspects of each borrow pit. The main aspects to consider are as follows:

- ease of access;
- rock type;
- overburden thickness;
- topography;
- current and historical uses;
- proximity to construction activities;
- visual impact; and
- impact on environmentally sensitive areas.

Steeper topography is preferable for quarrying, where peat and soils coverage will be limited. Careful consideration was given to landscape and visual impacts, and other considerations included proximity to watercourses and places of archaeological interest. The proposed borrow pits are in areas where the peat cover is typically thinner or vacant and aggregate reserves are expected to occur near the surface.

No intrusive site investigation works have been undertaken into the quality of rock that might be recovered at the time of preparing this BPA. However, it is anticipated that a full ground investigation will take place in advance of construction of the proposed development. The investigation will include the testing of material from within the proposed borrow pit areas to assess its suitability for re-use.

3.1 Aggregate Requirements

The proposed turbine locations and their subsequent maintenance would require the construction of a purpose-built network of access tracks. These tracks would be single track with occasional passing places, un-metalled and would be constructed to the turbine suppliers' specifications conforming to the Specification for Highway Works (SHW)¹.

As indicated above, a site investigation would be required to investigate each borrow pit location to confirm the material suitability and re-use potential of the bedrock with bedrock samples recovered from the borrow pits and subjected to detailed geotechnical testing.

The indicative volumes of aggregate required for site infrastructure are summarised in Table A.

¹ Highways Agency, Manual of Contract Documents for Highway Works Volume 1 Specification for Highway Works, Series 600 Earthworks, Published February 2017.



Table A: Aggregate Requirement Summary

Infrastructure Element	Volume of Aggregate Required (m ³)
Site Tracks (upgraded and new)	123,169
Site access and transit layby	1,670
Turbine bases (formation only)	4,232
Aggregate for Turbine Concrete ²	4,752
Fill above turbine bases (Backfill)	21,296
Hardstandings	15,360
Substation (noting only one will be built)	16,000
Temporary Compound 1	4,000
Temporary Compound 2	4,000
Batching Compound	2,000
Total	188,799

It has been estimated that approximately 188,799m³ of suitable quality rock would be required to construct the proposed development. This includes SHW¹ classes 6F2, 6N/ 6P and concrete aggregate. If rock quality is not suitable for each of these engineered materials, then there may be a requirement for imported materials.

No account has been taken in the calculations for the fortuitous ‘winning’ of rock during the construction phase for example during infrastructure excavations. If such rock was available, the amount extracted from the borrow pits would be reduced.

3.2 Borrow Pit Appraisal

This section of the report provides an assessment of the four borrow pit search areas together with an evaluation of their potential to meet the proposed development’s aggregate requirements.

A total of four search areas were selected as possible borrow pit locations, shown on **Figure 10.5.1**. Each location is reviewed in the sections below. Potential search areas have been highlighted with indicative excavation areas identified at each borrow pit location.

All borrow pits could be extended or reduced in size depending on review of aggregate requirements and/or ground investigation data.

These rock types have been assumed for the borrow pits where there were no rock exposures at the surface. The geology encountered within the proposed development is supported by BGS geological maps for the site. The dimensions of the borrow pits, volume of superficial material to be removed and volumes of site won rock for each borrow pit have been estimated based on cross-sections developed through a digital terrain model. These are required to be confirmed by future intrusive ground investigation works.

² It is assumed that 1m³ of concrete requires 1 tonne of aggregate. Aggregate required for concrete assumed at 1.75 tonne per 1m³. Other aggregate assumed at 2 tonne per m³.



3.2.1 Borrow Pit 1

Borrow Pit 1 (BP1) is proposed in the northwest of the proposed development and forms part of an existing active borrow pit, at approximately NGR 341910 858600, shown on **Figure 10.5.1** with further details in **Table B**.

Photo 1: View looking south from NGR 341986, 858697 showing BP1



Table B: Borrow Pit 1

Borrow Pit 1	
Excavation Area	Approximately 50,000m ²
Height of Excavation	Approximately 10m
Gradient	Slope increasing steeply towards the east
Details of Likely Extraction	Combination of digging, drilling and blasting
Likely Overburden Type and Depth	Bedrock at or near surface. Minimal superficial coverage with an average thickness of approximately 0.1m
Extent of Aggregate Extraction	Approximately 38,714m ³
Aggregate Composition	Findlater Flag Formation – Psammite and Semipelite Findlater Flag Formation – Quartzite (north eastern edge only)



3.2.2 Borrow Pit 2

Borrow Pit 2 (BP2) is proposed in the centre of the proposed development, at approximately NGR 343219, 858135, shown on **Figure 10.5.1** with further details in **Table C**.

Photo 2: View looking north from NGR 343234, 858098 showing BP2



Table C: Borrow Pit 2

Borrow Pit 2	
Excavation Area	Approximately 18,000m ²
Height of Excavation	Approximately 12.5m
Gradient	Slope increasing steeply towards the north
Details of Likely Extraction	Combination of digging, drilling and blasting
Likely Overburden Type and Depth	Glacial till with an average thickness of approximately 0.5m.
Extent of Aggregate Extraction	Approximately 80,200m ³
Aggregate Composition	Findlater Flag Formation – Psammite and Semipelite



3.2.3 Borrow Pit 3

Borrow Pit 3 (BP3) is proposed in the southeast of the proposed development and forms part of a historic borrow pit, at approximately NGR 347294, 857241, shown on **Figure 10.5.1** with further details in **Table D**.

Photo 3: View looking north from NGR 347288, 857237 showing BP3



Table D: Borrow Pit 3

Borrow Pit 3	
Excavation Area	Approximately 5,700m ²
Height of Excavation	Approximately 7.5m
Gradient	Slope increasing steeply towards the north
Details of Likely Extraction	Combination of digging, drilling and blasting
Likely Overburden Type and Depth	Bedrock at or near surface. Minimal superficial coverage with an average thickness of approximately 0.1m
Extent of Aggregate Extraction	Approximately 16,875m ³
Aggregate Composition	Findlater Flag Formation –Semipelite



3.2.4 Borrow Pit 4

Borrow Pit 4 (BP4) is proposed in the northeast of the proposed development and forms part of a historic borrow pit, at approximately NGR 347044, 860225, shown on **Figure 10.5.1** with further details in **Table E**.

Photo 4: View looking east from NGR 347039, 860315 showing BP4



Table E: Borrow Pit 4

Borrow Pit 4	
Excavation Area	Approximately 22,000m ²
Height of Excavation	Approximately 10m
Gradient	Slope increasing steeply towards the east
Details of Likely Extraction	Combination of digging, drilling and blasting
Likely Overburden Type and Depth	Bedrock at or near surface. Minimal superficial coverage with an average thickness of approximately 0.1m
Extent of Aggregate Extraction	Approximately 53,500m ³
Aggregate Composition	Findlater Flag Formation –Psammite and Semipelite



4.0 Proposed Borrow Pit Design

The indicative borrow pit volumes are presented in **Table B** to **Table E**. The design of the borrow pits anticipates extracting a net stone volume suitable for the requirements of the proposed development, excluding any imported material required for the enabling works and the creation of the new site entrance and initial section of track. This target capacity has been determined based on the estimated requirements for construction materials together with additional allowances for overburden material. It is envisaged that overburden/soils together with processed materials would be carefully stored adjacent to the excavation void for eventual use in the restoration process.

4.1 Marking Out and Overburden Stripping

The permitted extents of the borrow pit would be marked out with pegs, and overburden, including topsoil, subsoil and weathered rock horizons, would be stripped from within this delineated area.

The overburden and weathered rock horizons would be stripped using a combination of crawler tractor dozers and backtrackers with the material loaded by loading shovels. The overburden (including surface vegetation turves) would be carefully stripped and stored as a series of separate turves, topsoil, subsoil and weathered rock storage mounds to be used for reinstatement purposes.

4.2 Excavations within Rock

Once overburden and weathered rock horizons have been stripped, and stored, a suitably qualified geotechnical engineer/blasting engineer would assess the nature of the underlying solid rock strata. The engineer would provide advice on suitable extraction techniques including; extraction method, bench and cut face design parameters, and blasting design (if required).

If blasting is required, blasting would be undertaken in accordance with the Quarries Regulations 1999³ and Annex D PAN 50⁴.

A combination of digging, ripping and blasting would be utilised to excavate rock (subject to the nature of the material encountered, depth of weathering and level of fracturing) which would be processed using a mobile crushing and screening plant, which would be sited within the base of the working borrow pit.

4.3 Stockpiling of Materials

The initial overburden strip would be stored within temporary screening mounds around the perimeter of the borrow pit. The screening mounds would be at least 1.5m in height.

The remaining unsuitable materials (weathered/unsuitable rock horizons) would be stockpiled within the base of the working borrow pit. The stockpiles would have a maximum height of 5m, with maximum side-slope gradients of 1(Vertical (V)) in 2.5(Horizontal (H)) and be in full compliance with the Quarries Regulations 1999³ and Quarries National Joint Advisory Committee (QNJAC) Guidelines⁵. This material would be used as part of the restoration profiling on the cut faces.

³ Health and Safety Executive (2014), Health and Safety at Quarries, Quarries Regulations 1999, Approved Code of Practice and Guidance (Second Edition).

⁴ Scottish Government (2000), PAN 50 Annex D: Controlling the Environmental Effects of Surface Mineral Works.

⁵ Quarries National Joint Advisory Committee (2020), Available at: <http://qnjac.co.uk/what-is-qnjac/>. Last accessed April 2020.



4.4 Access Tracks/Haulage Routes

The proposed access to the borrow pit(s) would involve constructing access tracks from the main wind farm access track. The access tracks would include suitable roadside drainage ditches, with soakaways located, where appropriate.

The tracks (haulage routes) within the borrow pit would have a gradient of no steeper than 1(V) in 10(H).

4.5 Water Management/Drainage

The borrow pit(s) would feature a perimeter surface drain, which would aim to prevent water in-flow into the borrow pit. The water collected within the surface drains would be discharged either into the surrounding vegetation, or into suitably located settlement lagoons.

Where necessary, surface settlement lagoons would be constructed within the borrow pit. These would be constructed with the aim of containing any surface water collection within the excavation voids, and from collection of water from the perimeter surface drains. The lagoons would be contained within a bunded area at the base of the borrow pit, with suitable pumping systems installed allowing water to be pumped to soakaways as required.

4.6 Restoration

Upon completion of extraction at the borrow pit(s), surface profile restoration would be undertaken using the stockpiled overburden materials and other suitable materials excavated on-site (including peat) subject to review by the Environmental Clerk of Works (EnvCoW).

General fill material would be sourced from the stockpiles located within the borrow pit void. These would comprise of materials with unsuitable engineering properties for the proposed development construction such as weathered rock and unsuitable/poor quality rock horizons, and unsuitable materials arising from the crusher/blasting operations. This material would be utilised to provide the basis of the restoration profile.

The fill materials would be used as general fill to soften the benched profile of the excavations and provide a gentler sloping gradient than near vertical working face slope designs. The fill materials would also be used to provide a suitable gradient on the borrow pit floor to prevent ponding.

The stripped soils, and subsoil horizons which would be stored within perimeter screening mounds would be utilised as the surface dressing layer in which to provide a suitable medium for seeding and planting as appropriate.

The restoration of the borrow pit sites would not involve importing any material onto the proposed development. Only materials arising from the excavations would be utilised as part of the restoration scheme. The base of the borrow pit would re-use existing stockpiled materials/soils generated from the site excavations to create a habitat on the floor of the borrow pit, which would be a maximum of 2m thick across the floor area and if suitable, some of these soils could be used to 'dress' shallower side slopes but not on the steeper faces.

An EnvCoW would be in place, to monitor the restoration and aftercare of the borrow pits.

4.7 Best Practice Guidance Documents

A number of general pollution prevention measures would be employed to minimise the risks to ground and surface waters during the creation and use of the borrow pits. Extraction operations would be carried out in accordance with relevant SEPA Guidance for Pollution



Prevention⁶ and other codes of best practice, to ensure that both ground and surface waters are not contaminated. These would include relevant codes of best practice relevant to the site, including:

- European Commission (EC) Water Framework Directive (2000/60/EC);
- Planning Advice Note (PAN) 50, Controlling the Environmental Effects of Surface Mineral Workings Scottish Government (2000) ;
- Good Practice on Controlling the Effects of Surface Mineral Working on the Water Environment, Department of the Communities and Local Government and Mineral Industry Research Organisation (2008);
- The Water Environment (Controlled Activities) (Scotland) Regulations 2011;
- Guidance for Pollution Prevention (GPPs) (various dates and references), SEPA; and
- Environmental Good Practice on Site C692, CIRIA (2010).

⁶ SEPA (2019), Guidance for Pollution Prevention (GPPs). Available at <https://www.netregs.org.uk/environmental-topics/pollution-prevention-guidelines-ppgs-and-replacement-series/guidance-for-pollution-prevention-gpps-full-list/>



5.0 Conclusion

In summary, four borrow pits have been assessed as being capable of supplying all the aggregate required for the proposed development, excluding the concrete for the turbine bases and any enabling works. The locations and methods of working would be managed to cause minimal impact to the ground conditions and water environment. The borrow pit design and recommended methods of operation are in line with the Quarries Regulations, Approved Code of Practice, 1999 (as amended)⁷ to provide a safe working environment and minimise risk of instability.

An approximate volume of excavated materials has been calculated for each of the proposed borrow pit locations, these volumes are based on initial calculations based on assumptions for the proposed development. These calculations would be verified by detailed intrusive investigation at the proposed locations, post-consent. Calculations do not take into consideration the 'winning' of materials along the route. Each of the proposed borrow pits selected could be increased or decreased in size, depending on the aggregate requirements or following an assessment of the suitability of aggregate materials following detailed ground investigation.

The quality of rock anticipated on-site is inferred from a visual assessment of rock outcrops and published information. An intrusive ground investigation, sampling and material laboratory testing will be required to confirm ground condition and suitability.

Prior to the construction of the proposed development, design and best practices, and any required mitigation measures, would be set out in full within a Construction Environmental Management Plan (CEMP) and would be secured by an appropriately worded predevelopment condition of consent.

⁷ Health and Safety Executive (2014), Health and Safety at Quarries, Quarries Regulations 1999, Approved Code of Practice and Guidance (Second Edition).



Figures

Technical Appraisal 10.5: Borrow Pit Appraisal

Aultmore Wind Farm Redesign

Vattenfall Wind Power Ltd.

SLR Project No.: 405.03640.00016

1 December 2023



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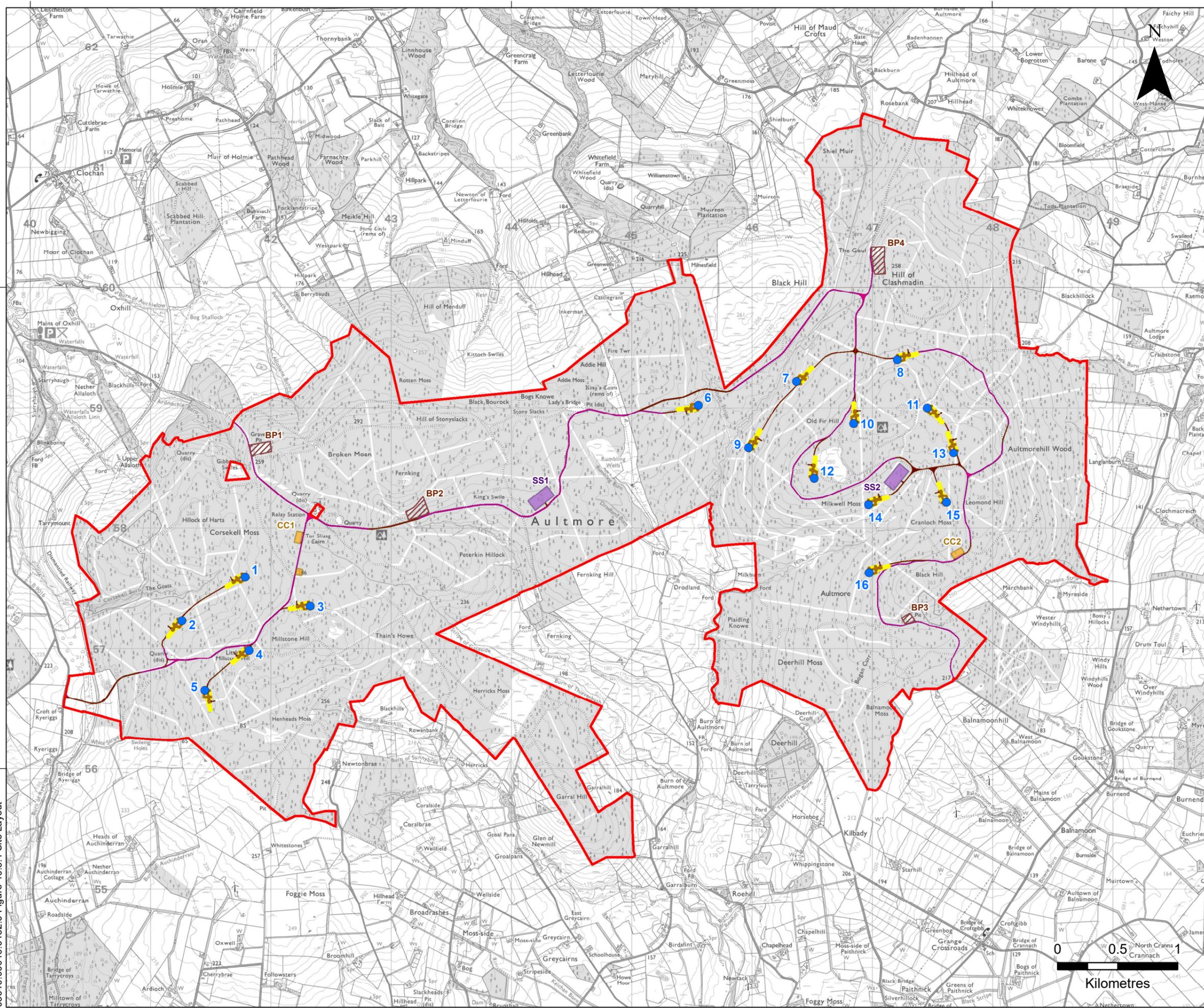
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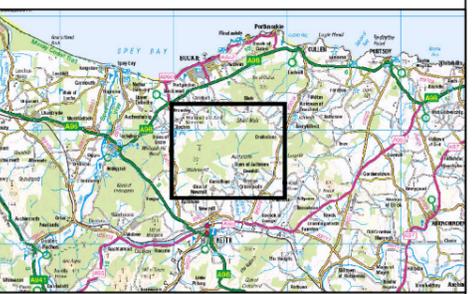
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03640.000/16.0132.0 Figure 10.3.1 Site Layout



LEGEND

- Site Boundary
- Turbine Location
- Permanent Hardstanding
- Temporary Hardstanding
- Substation Location
- Temporary Construction Compound Location
- Borrow Pit Search
- Upgraded Existing Track
- New Track



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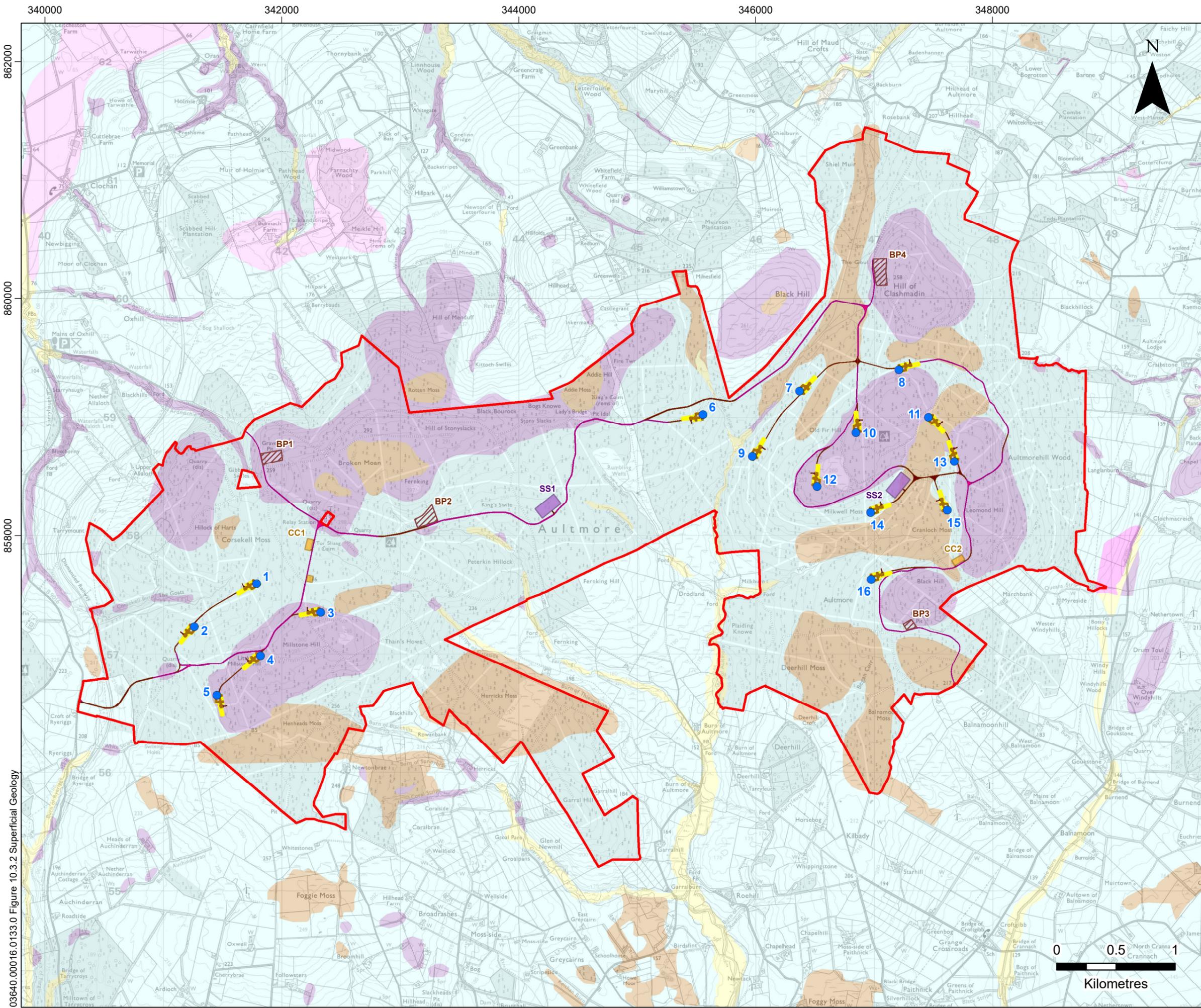
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SITE LAYOUT

FIGURE 10.5.1

Scale 1:30,000 @ A3 Date SEPTEMBER 2023



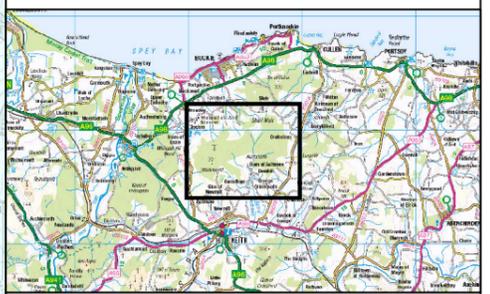


LEGEND

- Site Boundary
- Turbine Location
- Permanent Hardstanding
- Temporary Hardstanding
- Substation Location
- Temporary Construction Compound Location
- Borrow Pit Search
- Upgraded Existing Track
- New Track

Superficial Geology

- Alluvium - Clay, Silt, Sand and Gravel
- Peat - Peat
- Till, Devensian - Diamicton
- Glaciofluvial Ice Contact Deposits - Gravel, Sand and Silt
- Bedrock at or Near Surface



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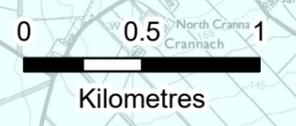
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SUPERFICIAL GEOLOGY

FIGURE 10.5.2



Scale 1:30,000 @ A3 Date SEPTEMBER 2023

03640.000/16.0133.0 Figure 10.3.2 Superficial Geology

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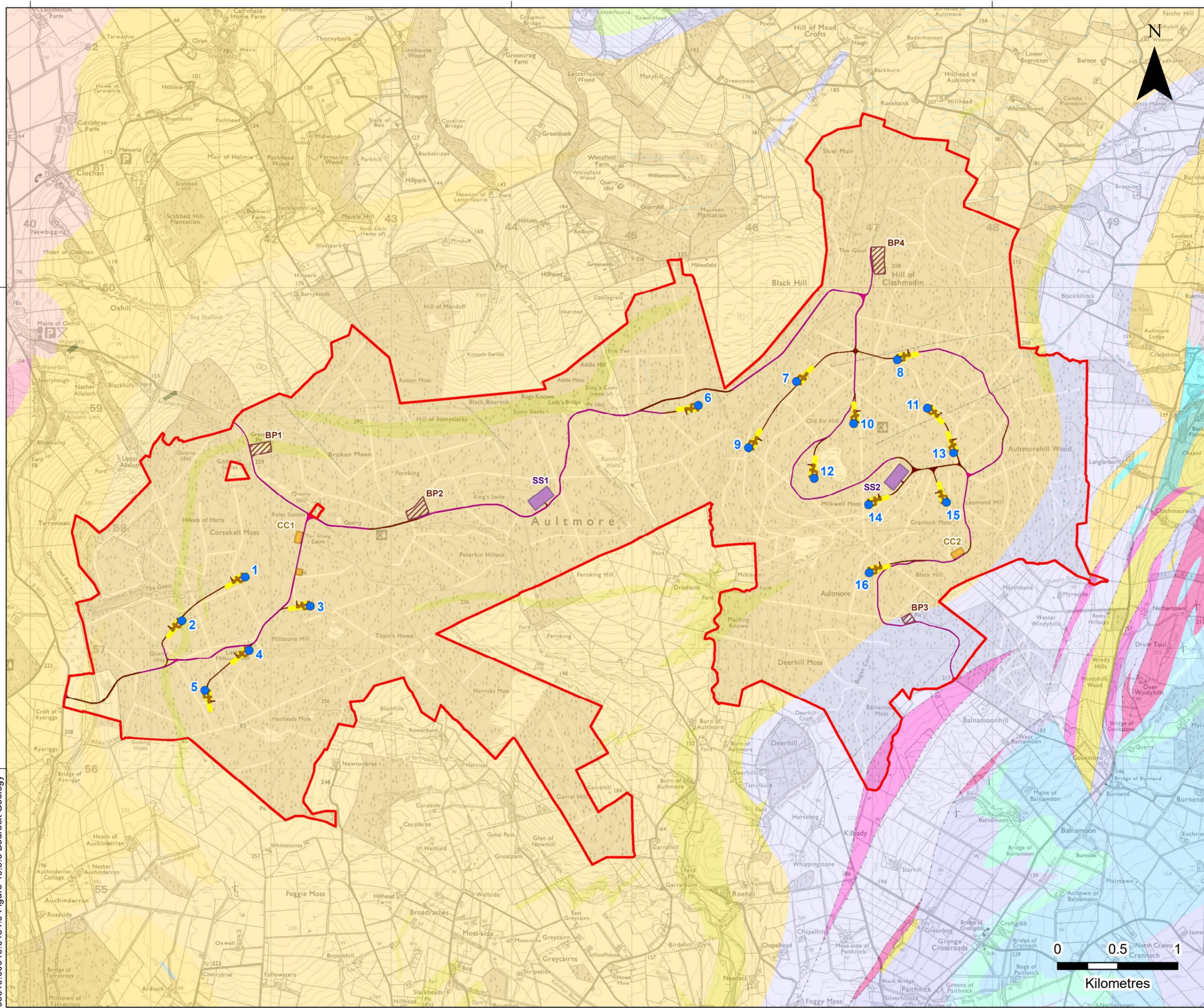
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LEGEND

- Site Boundary
- Turbine Location
- Permanent Hardstanding
- Temporary Hardstanding
- Substation Location
- Temporary Construction Compound Location
- Borrow Pit Search
- Upgraded Existing Track
- New Track

Bedrock Geology

- Spey Conglomerate Formation - Conglomerate (Devonian)

Metamorphic Rock (Period Unknown)

- Limehillock Limestone Member - Metacarbonate-Rock
- Findlater Flag Formation - Psammite And Semipelite
- Findlater Flag Formation - Semipelite
- Findlater Flag Formation - Quartzite
- Cairnfield Calcareous Flag Formation - Calcareous Psammite And Calcareous Semipelite
- Fordyce Limestone Formation - Pelite And Semipelite
- Keith Intrusions - Metagranite, Foliated
- Windyhills Intrusion - Metagranite

Linear Geology

- Fault, Inferred, Displacement Unknown



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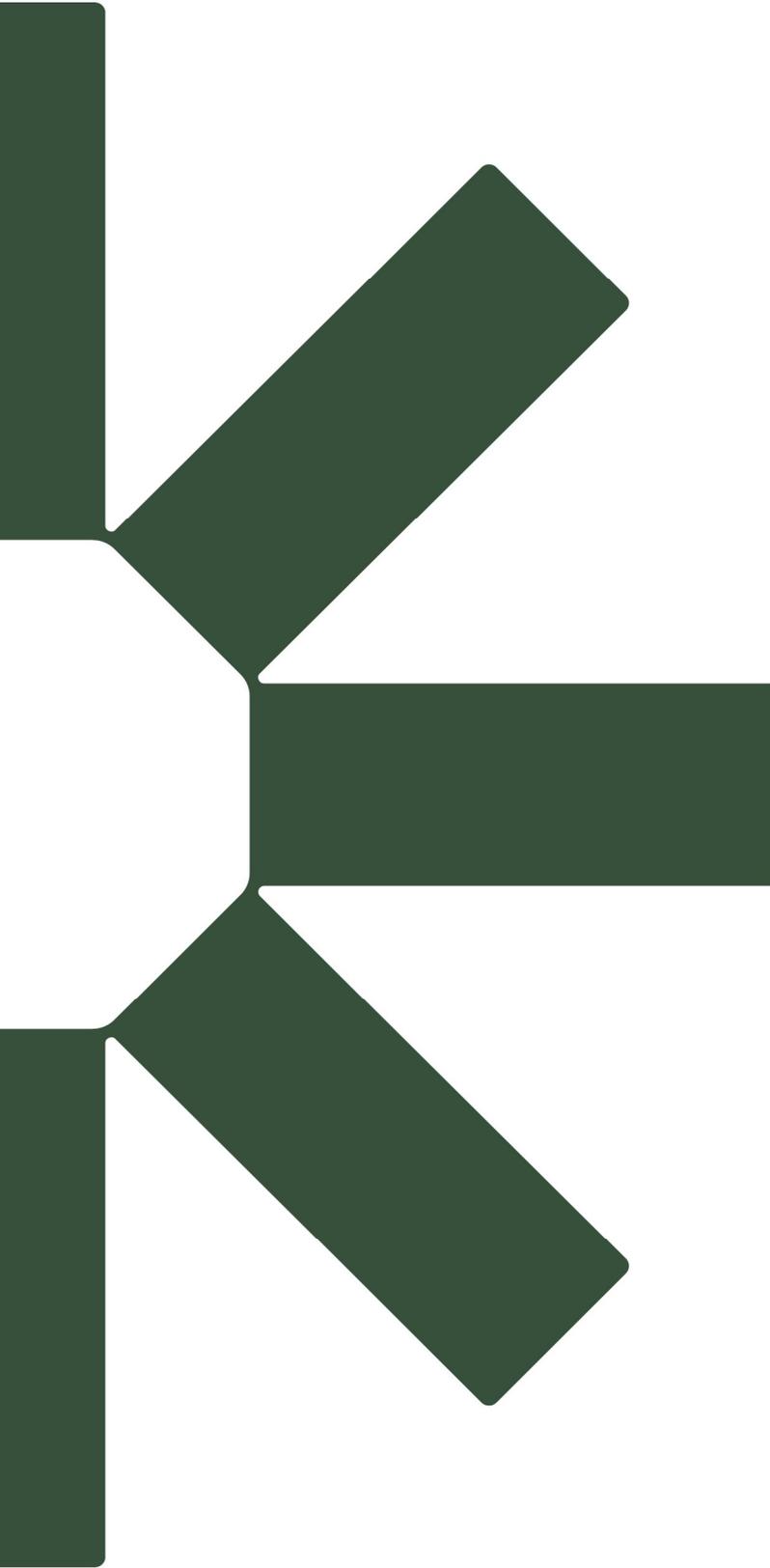
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BEDROCK GEOLOGY

FIGURE 10.5.3



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