

Chapter 2: Site Description and Design Evolution

Contents

2.1	Introduction	2-1
2.2	Site Selection and Consideration of Alternatives	2-1
2.3	Site Location and Description	2-3
2.4	Design Concept and Approach	2-4
2.5	Constraints and Identification Mapping	2-6
2.6	Design Evolution	2-9
2.7	Micrositing	2-13
2.8	Conclusion	2-13
2.9	References	2-13

2 Site Description and Design Evolution

2.1 Introduction

- 2.1.1 This chapter outlines the process undertaken in selecting the site as a potential location for a wind farm. It provides a description of the site and surrounding area and discusses the design evolution process that was undertaken to arrive at the final design described in Chapter 3.
- 2.1.2 The principles of the EIA process, that site selection and project design should be an iterative constraint-led process, have been followed in the preparation of the design of the Proposed Development. This has ensured that potential adverse impacts and effects, as a result of the Proposed Development, have been avoided or minimised as far as reasonably possible throughout the design process.
- 2.1.3 This chapter draws on issues considered in more detail in the relevant technical Chapters 7 to 17 of the EIA Report. This chapter does not pre-empt the conclusions of the technical chapters but explains how potential environmental effects have informed the design of the Proposed Development.
- 2.1.4 The Proposed Development is described in Chapter 3 and is shown on Figure 3.2. This chapter is supported by a Design and Access Statement (DAS) which is submitted as a supplementary report to this application.

2.2 Site Selection and Consideration of Alternatives

- 2.2.1 National Planning Framework 4 (NPF4) was adopted by the Scottish Government on 13 February 2023 and sets out the overarching spatial strategy for Scotland to 2045. The foundations for the spatial strategy as a whole are the global climate emergency and the nature crisis. NPF4 supports a large and rapid increase in electricity generation from renewable sources to meet Scotland's net zero emissions targets. It identifies that onshore wind energy development proposals will be supported in principle except for where these are located in National Parks and National Scenic Areas.
- 2.2.2 NPF4 identifies that there are significant opportunities to capitalise on the natural assets of Scotland to significantly reduce greenhouse gas emissions through increased renewable energy generation. The Proposed Development would make a valuable contribution to help Scotland meet its renewable energy and electricity production targets while supporting emissions reduction to combat global heating in the current climate emergency.
- 2.2.3 Regulation 5 (2) (d) and Paragraph 2 of Schedule 4 of The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 (the EIA Regulations 2017) requires that an EIA report should provide: *"a description of the reasonable alternatives studied by the developer, which are relevant to the development and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the development on the environment."* (Scottish Government, 2017).
- 2.2.4 The Applicant's approach to site selection is outlined here in relation to alternative sites considered. The do nothing alternative is also explained. The main alternatives considered for the site include design, turbine specification, location, size and scale. This chapter explores these options and explains how the final design of the Proposed Development has evolved.

Do Nothing Alternative

- 2.2.5 If the Proposed Development is not constructed, the land would continue to be used for commercial forestry. This option would have no beneficial impact with regards to the production of renewable energy, offsetting of greenhouse gas emissions or contribution to Scotland's renewable energy and net zero targets. One possible environmental benefit to the do nothing alternative would be that the forest would maintain its role in carbon sequestration, helping to mitigate climate change by absorbing carbon dioxide (CO₂) from the atmosphere, albeit within the context of ongoing forestry management and periodic felling/harvesting. However, as set out in the outline Nature Enhancement Management Plan (NEMP) (Technical Appendix 8.6) and Peatland Compensation Plan (Technical Appendix 8.5), biodiversity restoration and enhancement measures to include restoration of blanket bog, restoration of habitats within a local biodiversity site, improvements in the quality of a meadow (with associated benefits for wildlife), increasing nesting and foraging opportunities are proposed. On the basis of the potential beneficial environmental effects arising from the Proposed Development, the do nothing alternative is not considered to be the best environmental option. A consent application is therefore submitted to the Scottish Government Energy Consents Unit (ECU) to seek to contribute to Scottish targets and deliver more green electricity whilst also contributing to biodiversity enhancement measures on the site.

Site Selection

- 2.2.6 When taking into consideration the different constraints, it is estimated that around less than 10% of Scotland is suitable for wind farm development. Statkraft UK Limited undertakes a detailed feasibility of all sites identified as potentially suitable for onshore wind farm development. This feasibility assessment takes into consideration:
- the proximity of residential receptors;
 - the wind resource;
 - the presence and proximity of internationally, nationally and locally designated sites (for landscape, archaeology, ecology, water and geology);
 - the potential for protected species and/or habitats (including deep peat);
 - turbine delivery routes;
 - the location of other wind farm developments in the area; and
 - the local planning policy status for the area.
- 2.2.7 Statkraft UK Limited only takes forwards for development 2% of sites on which they do an initial feasibility assessment.
- 2.2.8 The site of the Proposed Development is centred on NGR 308300, 624200 and located at Tweedsmuir, approximately 12.5 km south of Broughton and 19 km north of Moffat, in the administrative jurisdiction of Scottish Borders Council (SBC).
- 2.2.9 The initial feasibility assessment identified that the Proposed Development site has:
- the presence of a very good wind resource (determined by initial desk based studies and wind monitoring on site);
 - no planning policies, which in principle, preclude wind energy development;
 - no internationally or nationally designated sites for ecology, landscape or geology within the site boundary;
 - compatibility with the existing commercial forestry use;
 - a minimum distance of 1 km could be kept between the turbines and the closest residential properties;
 - suitable ground conditions with limited areas of deep peat;
 - suitable access point from the adjacent A701; and
 - an existing network of tracks across the site which would help minimise the length of new track required by utilising and upgrading existing forestry tracks to service the Proposed Development where possible.

Technology, Size and Scale

- 2.2.10 Onshore wind continues to be the lowest cost form of renewable energy however the challenge is to meet the Scottish Government's ambitious 2045 Net Zero targets (see Chapter 4) within a context of limited UK Government financial support for onshore wind. The ability to maximise the potential yield from the site through turbine choice at the point of procurement is important for the financial feasibility of the Proposed Development in a time of increasing financial uncertainty, and to maximise the yield of the Proposed Development within set height constraints. Without the ability to optimise the Proposed Development in such circumstances, it may adversely affect the viability of the Proposed Development.
- 2.2.11 The supply of smaller turbines across Europe is already reducing due to lack of demand as manufacturers are recognising that the world market is shifting to larger machines and are focussing their development work on increasing capacity and efficiency of the turbine technology to secure the highest yield.
- 2.2.12 During the period leading up to any consent and ultimately construction of the Proposed Development, it is expected that the design and manufacture of commercial wind turbines will evolve and result in a wider choice of turbines than is currently available.
- 2.2.13 It is clear, therefore, that larger turbines (tip heights and rotor diameters) need to be considered in order to ensure a scheme's viability and constructability. In order to gain the maximum energy yield from the site, wind turbines up to 250 m to tip height were initially considered potentially viable and feasible in terms of delivery of components to the site.

- 2.2.14 However, based on concerns raised during the consultation stage regarding the scale of the proposed turbines and potential impacts on the residential amenity of some nearby properties, the proposed height of the turbines was reduced to a maximum of up to 200 m to blade tip.
- 2.2.15 Despite the continuing move towards larger turbines on the grounds of economic viability and available technology, it is also important to consider the site and its surroundings to understand what size of the turbine may be appropriate.
- 2.2.16 Multiple elements of the site and its surroundings were appraised when considering the appropriate turbine size that could be appropriate. These included:
- the proximity of nearby residential receptors, potential residential visual amenity, shadow flicker and noise issues;
 - proximity to areas categorised as 'Wild Land';
 - proximity to tourist attractions;
 - sensitivity to visible aviation lighting;
 - the ability to get wind turbine components to the site;
 - the scale of the local topography and surrounding hills and landscapes;
 - the landscape character type; and
 - the sensitivity of the landscape to tall turbines.
- 2.2.17 Taking the above inputs and considering them alongside the desire to get the maximum energy yield from the Proposed Development, it was concluded that the site could accommodate wind turbines up to 200 m to tip height. Turbines over 200 m were considered more likely to have an increased impact on residential amenities (both visual and noise) and the setting of heritage assets due to their scale in the landscape.

2.3 Site Location and Description

- 2.3.1 The site (the area encompassed by the application boundary) is located in the Tweed Valley in the Southern Uplands of Scotland. The site is dissected by the A701 with the majority of the site to the north of the road. All of the Proposed Development infrastructure would be located to the north of the A701 with the southern area proposed to be used for biodiversity enhancement measures. The site measures approximately 350 hectares (ha) and is comprised of commercial plantation forestry (currently managed by RTS Forestry) and open moorland, spread across the extent of three named hills, Upper Oliver Dod (490 m Above Ordnance Datum (AOD)); Weird Law (447 m AOD); and Glenmuck Height (472 m AOD). Elevations within the site decrease steeply from the north-east peak of Upper Oliver Dod to the River Tweed (south-east), at approximately 260 m AOD. The terrain is distinctly more elevated to the north-west and outwith the site at Gathersnow Hill (688 m AOD) and Coombe Hill (640 m AOD).
- 2.3.2 The portion of the site located to the south-east of the A701 adjoins the River Tweed. A number of small tributary watercourses flow into the River Tweed from the site including the Gala Burn, Rigs Burn, Bield Burn, Long Slack and Hallow Burn. The Fruid, Talla and Meggett Reservoirs lie at approximate distances of 2 km, 1.7 km and 8 km (respectively) to the south and east of the site.
- 2.3.3 The immediate surrounding area of the site is rural in nature, and residential properties are restricted to the village of Tweedsmuir and the lower elevations of the Tweed Valley in proximity of the A701. There are several residential properties clustered just north of the four-way road junction at Tweedsmuir, east of the site boundary, and several others between Bield Burn and Tweedsmuir, north-east of the site boundary.
- 2.3.4 Outwith Tweedsmuir, the remote setting of the site means there are no other settlements within 10 km of the site. The village of Broughton is located approximately 12.5 km north of the site and provides services and facilities to the local area including a post office, village store and Broughton Primary School. The town of Moffat in Dumfries and Galloway (approximately 19 km south) according to the National Records of Scotland, has a population in the region of 2,410 and is separated by the expansive upland hills comprising the Southern Uplands. The transport network in the wider vicinity of the site and Southern Uplands are very much limited to the A74 (M), A702, A701 and A708. These major roads all roughly follow a west south-west, east south-east alignment from Dumfries to Edinburgh and Selkirk, through the centre of the Southern Uplands range.
- 2.3.5 There are no national ecological designations within the site boundary. However, the River Tweed, adjacent to the site and into which tributaries of the site drain, is a Special Area of Conservation (SAC). Atlantic salmon (*Salmo salar*), otter (*Lutra lutra*) and aquatic vegetation are a primary reason and lamprey is a qualifying reason for this designation status. The River Tweed is also designated as a Site

of Special Scientific Interest (SSSI) for the same species (full details are noted in Table 8.5 of Chapter 8). Furthermore, salmon and lamprey are UK Biodiversity Action Plan species listed as priorities for conservation. The Glenmuck Bog Local Wildlife Site (LWS) and Local Biodiversity Site (LBS) are located within the site.

- 2.3.6 Other nearby natural heritage designations (within 10 km) include:
- Tweedsmuir Hills SSSI, approximately 2.4 km to the north-east (designated for bryophyte, upland and vascular plant assemblages);
 - Craigdilly SSSI, approximately 8.8 km to the south-east (designated for sub-montane scrub); and
 - Moffat Hills SAC and SSSI, approximately 9.2 km to the south-east (designated for acidic scree, alpine and subalpine heaths, blanket bog, dry heaths, upland habitat and vascular plant assemblages).
- 2.3.7 There are three Scheduled Monuments within the site boundary:
- Weird Law, Platform Settlement (SM3529).
 - Menzion Farm, Enclosed Cremation Cemetery (SM2702).
 - Menzion Farmhouse, Two Enclosed Cremation Cemeteries (SM2748).
- 2.3.8 A number of Scheduled Monuments are also in close proximity to the site and within the wider area, the closest of which are Oliver Castle Fort (SM3144) and Oliver Craggs Fort (SM2947). In addition, there are three Category B Listed Buildings within 1 km of the site. Chapter 11 provides detailed descriptions of the archaeological features and heritage assets in the vicinity of the site and assesses the potential for significant effects on such features and assets resulting from the Proposed Development.
- 2.3.9 The site does not lie within any nationally designated landscapes. The Upper Tweeddale National Scenic Area (NSA) covers approximately 12,770 ha and is located approximately 4 km north-west of the site encompassing the expanse between Broughton to Peebles in the north-east. A number of Gardens and Designed Landscapes (GDL) occur across the study area, the closest is Dawyck GDL, which lies approximately 12 km north-east of the Proposed Development.
- 2.3.10 The site lies within the Tweedsmuir Uplands Special Landscape Area (SLA). SLAs are a local landscape designation and are areas that are considered to have particular landscape qualities that make them more sensitive to development. The designation statement for the Tweedsmuir Uplands describes the SLA as “a highly scenic area of dramatic landform” and having “a significant degree of wildness” “The large reservoirs are the only substantive human incursion, but add variety rather than reducing remoteness.” (SBC, 2012).
- 2.3.11 The predominant Landscape Character Types (LCTs) of the site are characterised as ‘Upland Valley with Pastoral Floor’ and ‘Southern Uplands Borders’; whereby the Proposed Development will mostly utilise the elevated fraction of the site known as Southern Uplands Borders LCT. Chapter 7 identifies and assesses the potential effects that the Proposed Development would have on the landscape, views and visual amenities of the local environment.
- 2.3.12 Approximately 2.4 km to the north of the site is the operational Glenkerie Wind Farm (11 turbines)¹. To the west of the site lies the operational Clyde Wind Farm (approximately 6.8 km) and its Extension (approximately 2.5 km) (totalling 206 turbines), and approximately 3.0 km to the south of the site Whitelaw Brae Wind Farm (14 turbines) is under construction.

2.4 Design Concept and Approach

Constraints Led

- 2.4.1 In EIA, constraint identification should continue throughout the design process in order to take cognisance of new, more detailed surveys revealing additional limitations or required changes to the development. This allows the findings of technical and environmental studies to inform the design of a development and achieve a ‘best fit’ within the environment of a development site.

¹ All measurements taken from the nearest proposed turbine to existing/ under construction turbine.

2.4.2 This approach has been adopted in respect of the Proposed Development. Where potentially significant effects have been identified, efforts have been made to avoid these by evolving the design of the Proposed Development. This is referred to within the EIA Report as mitigation embedded in the Proposed Development's layout and design, or simply 'embedded mitigation'. Information on embedded mitigation is explained further within each technical chapter of the EIA Report, as appropriate. Several design principles and environmental measures have also been incorporated into the Proposed Development as standard practice.

2.4.3 Embedded mitigation includes, but is not limited to:

- considering the size and scale of the Proposed Development appropriate to the location;
- use of existing tracks within the site and upgrading these to minimise groundworks;
- design of access tracks to minimise cut and fill, reducing landscape and visual effects as well as costs;
- sensitive siting of the proposed infrastructure incorporating appropriate buffer distances from environmental receptors (including nearby residential properties) to avoid or reduce effects;
- considering the appearance, finish and colour of wind turbines and the control buildings in accordance with the now NatureScot (NS) (formerly Scottish Natural Heritage (SNH)) guidance 'Siting and Designing Wind Farms in the Landscape', Version 3a (SNH, 2017);
- inclusion and design of borrow pits to minimise the amount of the material required to be imported to the site; and
- potential for up to 100 m micrositing of infrastructure during construction to ensure the best possible location is chosen based on site investigations.

Landscape and Visual

2.4.4 Throughout the design evolution of the Proposed Development's layout, a key driver has been the consideration of potential effects on landscape and visual receptors and how the Proposed Development would relate to the existing landscape character and the visual amenity from nearby residential properties. In particular, due attention was given to the scale and number of turbines proposed. The landscape and visual effects potentially caused by the Proposed Development have been considered extensively from key receptors. The resulting analysis has been an important input into the design evolution process and in particular to the layout design of proposed turbines and the location of infrastructure on the site.

2.4.5 'Siting and Designing Wind Farms in the Landscape', Version 3a states that: *"In a wind farm, turbines can be arranged in many different layouts. The layout should relate to the specific characteristics of the landscape – this means that the most suitable layout for every development will be different. For a small wind farm, this might comprise a single row of wind turbines along a ridge; while, for a larger development, a grid of wind turbines is often taken as a starting point, with turbines spaced at minimum technical separation distances."* (SNH, 2017).

2.4.6 The layout and design of the Proposed Development evolved as part of an iterative design process. An iterative design approach works in tandem with the EIA process and facilitates a receptive design process aimed at reducing the potential landscape and visual effects of the Proposed Development whilst taking into account other site constraints and maximising yield.

2.4.7 It is considered that the design respects the form of the underlying landscape and its scale by creating a grouping that appears as a staggered double row along the ridge or informal group in most views from the surrounding areas and using a single size of turbine across the site in order to reduce potentially adverse visual effects. The location of turbines was influenced by site constraints as well as the aim to create a coherent appearance from most viewpoints.

Efficiency Modelling

2.4.8 Throughout the constraints-led design process, wind and yield analysis was undertaken to ensure changes made to layouts did not adversely affect the output of the Proposed Development.

Stakeholder Consultation

2.4.9 Statutory consultees were invited to input to the design process for the Proposed Development. SBC major applications pre-application advice was used for the Proposed Development. A pre-application meeting was held with SBC in January 2023 and feedback from this meeting and from other consultees has been incorporated into the design evolution process.

- 2.4.10 Two public consultation events were undertaken each in Tweedsmuir and Broughton in March 2023 and March 2024 (four events in total) which allowed members of the local community to comment on the design proposals. Feedback from the public consultation events was incorporated into the design evolution process where possible and is presented in the Pre-Application Consultation (PAC) Report accompanying this application. Further details of the public consultation process can be found in Chapter 6.
- 2.4.11 In addition, two meetings were held with Tweedsmuir Community Council in January 2023 and February 2024 and one meeting was held with Upper Tweed Community Council in February 2024. Discussions with communities will continue throughout the post-submission period, construction and up to decommissioning (refer to Chapter 6 and the PAC Report for further information).

2.5 Constraints and Identification Mapping

- 2.5.1 The design of any wind farm is driven by the key objective of positioning turbines so that they capture the maximum energy possible within a suitable area while minimising the environmental effects.
- 2.5.2 The designations within the site and surrounding area were identified as the first part of the constraints mapping process. These are shown on Figure 2.1. The known environmental and technical constraints within the site were identified through this early-stage constraints mapping (Figure 2.2). It is important to note that the identification of a constraint does not necessarily result in the exclusion of that area from the potential development envelope; rather it means that careful thought and attention was paid to the constraint and the design followed appropriately. The key constraints which were taken into account during the design process included:
- topography and ground conditions (including peat);
 - environmental designations;
 - identified landscape and visual constraints;
 - proximity to residential receptors (with regards to visual amenity, shadow flicker and noise);
 - presence of protected habitats and species;
 - presence of watercourses, private water supplies and related infrastructure;
 - presence of cultural heritage features;
 - aviation and radar constraints;
 - recreation resource (no Rights of Way or Core Paths within the site);
 - forestry; and
 - fixed communications links.
- 2.5.3 The identification of constraints continued throughout the design evolution process as more detailed surveys refined the development envelope, as shown on Figure 2.2.
- 2.5.4 A description of how the various environmental and technical disciplines have contributed to the design through detailed assessment is described below. Information in respect of the survey work undertaken is provided in Chapters 7 to 17.

Topography and Slope Stability

- 2.5.5 The topography of the site has meant that gradients greater than 15 degrees have been avoided for the siting of wind turbines.
- 2.5.6 Slope stability has been taken into consideration to understand whether infrastructure could be located within certain areas of the site. Where slope stability was identified as an issue, these areas were deemed to be unsuitable for infrastructure and have therefore been avoided due to the potential for slope instability and peat slide risk.

Designated Landscapes and Visual Amenity

- 2.5.7 No international or nationally designated landscapes occur within the site. However, the south-western boundary of the Upper Tweeddale NSA comes to within approximately 6 km of the Proposed Development. A number of Gardens and Designed Landscapes (GDL) occur across the study area, the closest is Dawyck GDL, which lies approximately 12 km north-east of the Proposed Development.
- 2.5.8 There are also a number of local landscape designations within the 45 km initial study area. These designations have been considered during the design process and include:
- Tweedsmuir Uplands SLA (the site sits within this SLA);

- Tweed Valley SLA which bounds the Tweedsmuir Uplands SLA to the east at approximately 20 km north-east of the Proposed Development;
 - Tweed, Ettrick and Yarrow Confluences also adjoin the Tweedsmuir Uplands SLA to the east;
 - Moffat Hills Regional Scenic Area (RSA) in the Dumfries and Galloway Council (DGC) area extends to the south-western boundary of the Tweedsmuir Uplands SLA;
 - Teviot Valleys SLA, the western boundary of which comes within the edge of the 45 km study area; and
 - Pentland Hills SLA which lies approximately 10.5 km north of the Proposed Development.
- 2.5.9 Wildland is recognised as a resource of national importance, although Wild Land Areas (WLAs) are not designated. The Talla-Hart Fell WLA lies approximately 9 km to the south-west of the Proposed Development.
- 2.5.10 Potential landscape and visual effects have been considered throughout the design evolution process. Several turbine and infrastructure layouts were considered during the design process, with the layout evolving to respond to landscape and visual constraints such as views from the A701, views from Tweedsmuir and views from local residential receptors. The potential for cumulative effects of the Proposed Development along with existing operational, under construction, consented and application stage wind farms in the study area have also been a landscape and visual consideration throughout the design evolution process.
- 2.5.11 The final layout has been optimised with regards to landscape and visual as far as possible using the agreed viewpoints for the Landscape and Visual Impact Assessment (see Chapter 7 for further information).
- 2.5.12 Where possible, proposed excavations for new sections of access tracks and other infrastructure have been minimised. The location of the substation compound, BESS site and temporary construction compound have been given particular consideration in relation to reducing potential landscape and visual effects. These have been located on lower ground within the southern part of the site where landforms and vegetation help to reduce the potential prominence of the structures.

Ecology and Ornithology

- 2.5.13 Ecology and ornithology surveys were undertaken across the site between March 2022 and April 2024, in order to identify any broad areas of constraint to the Proposed Development. Constraints mapping included the identification of sensitive ecological features, including habitats present within the site. Where relevant, buffers were placed around any sensitive features and the design of the site was amended accordingly. Protected species surveys were undertaken within the site but no constraints to development were identified.
- 2.5.14 Areas with the potential to be Groundwater Dependent Terrestrial Ecosystems (GWDTEs) were found to be limited in extent within the site. The design of the Proposed Development sought to minimise any effects on potential GWDTEs through taking account of habitat (National Vegetation Classification, NVC) information, along with other site constraints, in layout iterations; however, the assessment presented in Chapter 10 confirmed that there are no actual GWDTE within the site to be avoided.
- 2.5.15 Glenmuck Bog, a Local Wildlife Site (LWS) and Local Biodiversity Site (LBS) is located within the site as shown out on Figure 8.2. A limited NVC community of M19a habitat was identified in the north-west and south of the site as shown out on Figure 8.6b and these constraints have been taken into account in the design evolution process.

Peat

- 2.5.16 The majority of the site lies within Class 3 peatland. Class 3 peatland is not considered priority peatland although occasional peatland habitats can be found, and most soils are considered carbon rich with some areas of deep peat. Small areas of Class 4, Class 5 and Class 0 peatlands are noted within the site, particularly within the south-eastern extent of the site. Class 4 and Class 5 peatlands are considered to be areas unlikely to be associated with peatland habitats however the soils may remain carbon rich and contain areas of deep peat. Class 0 is a mineral soil and does not represent a peatland habitat.
- 2.5.17 As part of the baseline assessment, a comprehensive peat probing and condition assessment programme was completed between September 2022 and February 2024, the results of which are presented in full in the Peat Management Plan (PMP) in Technical Appendix 10.1 and the Peat Landslide and Hazard Risk Assessment (PLHRA) in Technical Appendix 10.2.
- 2.5.18 Detailed constraints advice was provided to the project team during the iterative layout design process for the turbines and associated infrastructure features. At various stages during the determination of the design, fieldwork was undertaken to provide feedback to the team. This approach identified site

constraints in order to minimise a number of potential adverse effects on peat, by undertaking initial peat depth and stability studies to avoid deeper peat areas.

- 2.5.19 Informed by the extensive programme of peat probing undertaken across the site, the design has sought to avoid areas of deeper peat (>1 m) where technically feasible, and where possible limit development to areas of peat less than 1 m deep or where peat is absent.

Hydrology and Hydrogeology

- 2.5.20 A 50 m buffer zone has been applied around the primary watercourses which traverse the site. These buffers were used to ensure that turbines and infrastructure, other than tracks, were not located in close proximity to hydrological features in accordance with wind farm construction best practice guidelines (as noted in Chapter 10). This reduces the risk of run-off and water pollution into existing watercourses.
- 2.5.21 Although some of the existing tracks are less than 50 m from a watercourse, the use of the existing tracks was identified as the best design option as it minimised the need for new tracks.
- 2.5.22 No new watercourse crossings have been proposed as part of the Proposed Development although one existing watercourse crossing may need to be improved, subject to detailed design.
- 2.5.23 Data on private water supplies (PWS) was obtained from SBC and supplemented with data from a PWS survey conducted on-site in December 2023. A PWS assessment is presented in Technical Appendix 10.3. PWS were identified in the eastern part of the site, supplying properties outwith the south and eastern extent of the site boundary. The catchments have been avoided by moving the proposed turbines west to ensure that no effects would result.

Archaeology and Cultural Heritage

- 2.5.24 There are three Scheduled Monuments within the site boundary and a further 11 Scheduled Monuments within 1 km of the site. There are three Category B Listed Buildings within 1 km of the site and a number of non-designated heritage assets within the site and within 1 km of it.
- 2.5.25 The consideration of heritage assets, particularly the Scheduled Monuments within the site have been given due consideration throughout the design evolution process through review of visualisations. This includes avoiding siting wind turbines and other infrastructure near the Scheduled Monuments within the site to avoid direct impacts and also designing the wind turbine layout with cognisance of views from Scheduled Monuments located within 10 km of the site to ensure turbines would not be seen directly in the backdrop of the designated heritage assets in views between assets and across the Tweed Valley.
- 2.5.26 Non-designated heritage assets within the site were verified through survey and buffered by 10 m during the design process to ensure no direct impacts. Five assets are located within 50 m of the proposed infrastructure, and these will be fenced off during construction to ensure they are protected.

Noise

- 2.5.27 For the purposes of early constraints mapping, a buffer of 1 km was applied to residential properties in the vicinity of the site. The distance of these buffers was further refined during the design process based on expert noise advice following noise monitoring measurements at three locations in proximity to the site.
- 2.5.28 Noise modelling was undertaken for the proposed turbine layout at various stages of the design process, to predict the likely sound level which would result from the Proposed Development at nearby residential properties. The difference between measured background noise levels and predicted noise levels needs to be compliant with ETSU-R-97: 'The Assessment and Rating of Noise from Wind Farms' (Department for Trade and Industry (DTI), 1996) to avoid a significant adverse effect. ETSU-R-97 is endorsed by national planning policy (and the Scottish Borders Local Development Plan) as the appropriate guidance document for the assessment of noise from wind turbines. Applying design criteria in accordance with ETSU guidance, therefore, ensures that no exceedances of acceptable noise levels would occur for the Proposed Development.
- 2.5.29 During design evolution, noise considerations formed an important design consideration to the positioning of turbines in order to ensure that the maximum distances possible were employed between residential properties and the proposed turbines.

Shadow Flicker

- 2.5.30 Shadow flicker is considered to potentially be an issue for properties which are closer to a wind turbine than a distance of ten times the rotor diameter of the proposed turbines. Potential shadow flicker effects were a consideration during the constraints mapping process. SBC requested during Scoping that shadow flicker is assessed within 2 km of the proposed turbines. Shadow Flicker is considered further in Chapter 17.

Aviation

- 2.5.31 The potential aviation constraints on wind turbines at the site were identified during the EIA process. These are as follows:
- potential effect on the NATS Lowther Hill radar; and
 - the requirement for aviation lighting.
- 2.5.32 The Applicant is in dialogue with NATS En Route regarding a defined and suitable mitigation strategy. The Proposed Development will be fitted with aviation safety lighting in accordance with the reduced lighting scheme outlined in Technical Appendix 16.1. The reduced scheme, whereby only three out of the seven turbines (Turbine 1, Turbine 3 and Turbine 6) would be visibly lit, has been approved by CAA and will ensure that lighting is minimised while meeting safety requirements.

Recreation

- 2.5.33 Consultation has been undertaken with Scotways who have confirmed that there are no rights of way within the site boundary. The SBC core path record also confirms that there are no core paths within or in the vicinity of the site. There were therefore no recreational constraints identified within the site to consider.
- 2.5.34 In order to enhance the recreation of the area, the Proposed Development includes the creation of a recreational heritage trail starting in the south-eastern section of the site, linking with the wider wind farm tracks, creating a circular loop. The trail would include interpretation boards at various points along the route to point out features of cultural heritage and ecological interest in the area. It is intended that part of the recreational heritage trail would be accessible to all users.

Forestry

- 2.5.35 The site includes large portions of commercial forestry which have been considered throughout the design evolution of the Proposed Development.
- 2.5.36 Use of existing tracks within the site and containment of the Proposed Development to the western side of the site has reduced the area of felling. Approximately 50.4 ha of felling is proposed in order to accommodate the Proposed Development, however compensatory planting of approximately 26 ha is also proposed, some of which would be restocked on site.
- 2.5.37 The area of required felling and the requirement for compensatory planting are considered further in Chapter 15.

Telecommunications

- 2.5.38 Consultation with Ofcom and fixed link operators did not identify any fixed telecommunication links which run through the site and could potentially be affected by the Proposed Development. More detail is provided in Chapter 17.

2.6 Design Evolution

- 2.6.1 GIS constraints mapping was used to identify the areas within the site which may be suitable for wind turbines and associated infrastructure. All known constraints gathered throughout the EIA process were used to inform the evolution of the location of the proposed turbines and associated infrastructure. During design optimisation, the locations of infrastructure and track design was refined in order to minimise the volume of earthworks and cut and fill required to construct the Proposed Development.

Turbine Layout Evolution

- 2.6.2 The design optimisation process was iterative, with each design involving a review of wireline visualisations from key landscape and visual receptors, consideration of setting impacts on cultural heritage assets, potential noise effects on residential properties, impacts to peat, hydrology, ecology and consideration of the energy generation seeking to maximise wind yield.
- 2.6.3 Turbine tip heights explored during the design process ranging from 200 m to 250 m, including the use of varied tip heights across the site.
- 2.6.4 Four of the key design iterations for the Proposed Development are shown on Figure 2.3 and detailed in Table 2.1.

Table 2.1 – Design Iterations

Layout	No. of Turbines	Description
A (Scoping Layout)	10	– Presented in the EIA Scoping Report November 2022. – Tip heights of up to 250 m.

Layout	No. of Turbines	Description
		<ul style="list-style-type: none"> - Layout A took into account initial desk-based observed constraints including ecologically important sites, sites of archaeological and/or cultural heritage importance, landscape designations, residential properties, watercourses and slope. - Desk-based constraints were also augmented by the results of field-based survey work to input to Layout A. At the Scoping stage, ornithological surveys had been ongoing for approximately nine months. Ecology habitat and protected species surveys, a Phase 1 peat probing exercise and a cultural heritage visit of the site and surrounding area had been completed. - Layout A was presented during an initial round of public and online consultation in February and March 2023.
B	8	<ul style="list-style-type: none"> - Layout B (March 2023) followed the first round of public and online consultation. The proximity of turbines to local properties and the settlement of Tweedsmuir were raised as concerns by attendees of the public and online consultation events. Other concerns raised included the number of wind farms in the surrounding area, the height of the turbines and potential impacts on private water supplies (PWS). - Layout B sought to reduce the potential visual impact of the turbines from the village of Tweedsmuir, to reduce the cumulative impact of the Proposed Development from key viewpoints and improve the separation distance between the proposed turbines and the Weir Law Scheduled Monument (SM) in the south, reducing visibility behind the SM (as advised by Historic Environment Scotland (HES). Turbine 8 was removed from Layout A on this basis. Removal of this turbine also reduced potential noise impacts by ensuring suitable setback distances from properties. - Turbine 4 from Layout A was also removed as part of Layout B in order to comply with setback distances from watercourses and remove any potential for effects on PWS by locating infrastructure outwith the PWS catchment. The proximity of this turbine to the site boundary was also causing issues in allowing suitable space for laydown areas for turbine components. - Local Biodiversity and Wildlife Site (LBS/LWS) Glenmuck Bog was discussed during the design iteration and it was agreed that further survey work would be undertaken in order to assess the condition of this LBS/LWS to feed into the next layout iteration. - As set out in Figure 2.3, other turbines were adjusted in location to improve the spacing between turbines from a landscape and visual perspective and to improve the location of hardstandings relative to the topography on-site.
C	7	<ul style="list-style-type: none"> - Layout C (August 2023) was designed following the results of a noise monitoring survey that was conducted in July 2023. This layout was also informed by responses received to the EIA Scoping Report, feedback from discussions with consultees and further ecological, landscape and visual and cultural heritage survey work. - Turbines were renumbered 1 to 7. - Turbine 9 (Layout B) was removed from this layout due to concerns related to potential noise impacts and impacts on cultural heritage assets within the site and in order to reduce landscape and visual effects. - Turbine 10 (Layout B, re-numbered to Turbine 1 in this layout) was moved out of the area in proximity of the Glenmuck Bog whilst Turbines 3 and 5 (of Layout B) were moved south to avoid an area of bog habitat identified during the ecological survey work. - Spacing between proposed turbines was increased to reduce the wake losses and improve operational efficiency. - Identification that the existing on-site track would be used as a main spine road with this layout.
D (Application Layout)	7	<ul style="list-style-type: none"> - Extensive design work was carried out throughout the end of 2023 and into 2024 to create an optimal layout for the Proposed Development, Layout D. - Layout D was developed following the additional noise modelling, results of a Phase 2 peat probing exercise that was completed on the site in early February 2024 and a PWS site survey conducted in December 2023. - Turbine 1 was moved west to increase separation from Turbine 7 and increase operational efficiency. - Turbine 5 was moved slightly north to avoid areas of deep peat. - Turbine 6 was moved west to respond to landscape and visual concerns, reducing the visual envelope of the Proposed Development. - Based on concerns raised during consultation regarding the scale of the proposed turbines and potential impacts on the residential amenity of nearby residents, the decision was made to reduce the proposed height of the turbines to a maximum of 200 m to the blade tip.

Layout	No. of Turbines	Description
		<ul style="list-style-type: none"> - The final locations and dimensions for the substation compound, temporary construction compound, BESS compound and borrow pit search areas were also confirmed in this layout. - This layout takes into account responses received to the EIA Scoping Report, feedback from discussions with consultees, information from the environmental survey / assessment work, and feedback received from the first round of public exhibitions and community council meetings. The design work reviewed available constraints, particularly in relation to the potential effects on noise, landscape and visual, residential amenity, peat and bog habitats, proximity to cultural heritage assets and distance to watercourses and private water supplies as well as slope and constructability. The review resulted in the removal of three turbines (Turbines 4, 8 and 9 from Layout A) reducing the Proposed Development to seven turbines. - Layout D comprises seven turbines, with blade tip heights of up to 200 m shown on Figure 3.2. This was considered to be a significant improvement from Layout A the Scoping Layout presenting a clear design rationale for the Proposed Development. The consistent spacing and elevation of the turbines simplify the appearance of the Proposed Development and avoid the clustering and stacking of turbines associated with earlier design iterations. - The final design also utilises approximately 3.5 km of existing forestry access tracks on the site minimising the amount of additional track that is required to be constructed for the Proposed Development to 1.5 km. - The final site survey and environmental assessment work was carried out using this layout.

Other Site Infrastructure

Site Access and Site Tracks

- 2.6.5 Access to the site would be afforded from the existing forestry access point to the site from the A701, as set out on Figure 3.1.
- 2.6.6 A number of different track layout options were considered as part of the site design process with four key track layouts (1 to 4) shown on Figure 2.4². The key aim was to maximise the use of the existing tracks on-site to minimise the amount of land taken and disturbance to habitats.
- 2.6.7 In the final track layout (shown as Layout 4, Figure 2.4), approximately 3.5 km of existing forestry access tracks on the site have been utilised thereby minimising the amount of new tracks required to be built for the Proposed Development to approximately 1.5 km.
- 2.6.8 The new sections of on-site access tracks and associated drainage have been carefully designed to avoid areas of deep peat, and potential peat slide risk and minimise cut and fill requirements as far as possible in order to reduce the amount of ground disturbance, amount of material required for construction, loss of sensitive habitats and landscape and visual effects, particularly during construction. The possible track routes were probed extensively as part of the phase 2 peat probing exercise and re-routed as appropriate to avoid any deep peat areas and areas of potential peat instability. Routing through isolated areas of the M19 bog habitat was carefully considered on balance with potential effects on deep peat, increased felling and watercourse buffers.
- 2.6.9 All access tracks have been designed with cognisance of the topography of the site to ensure constructability and permit the safe delivery of turbine components and associated parts.

Turbine Foundations and Hardstanding Areas

- 2.6.10 The turbine foundations and adjacent crane hardstanding and laydown areas have been located and orientated appropriately to ensure they are positioned on peat not greater than 1 m in depth (informed through peat probing) where possible and in accordance with contours to minimise the amount of cut and fill required. Peat stability has also been taken into account in the location of this infrastructure.
- 2.6.11 Near proposed Turbine 4 there are a few pockets of peat deeper than 1 m although these areas would be subject to additional peat probing and site investigation prior to construction to ensure that minimal disturbance results, micrositing the infrastructure appropriately.

Borrow Pit Search Areas

- 2.6.12 Borrow pits would be required as a source of rock to be used in the construction of the tracks and hardstandings. On-site borrow pit search areas have been identified based upon a review of geological mapping and site reconnaissance by an engineer and geological specialist, in order to reduce the need

² Note: Track Layouts 1 to 4 (Figure 2.4) do not correspond exactly to Turbine Layouts A to D (Figure 2.3) since tracks were not proposed until after Turbine Layout B was proposed.

to transport large quantities of aggregate. The location of each borrow pit search area was considered and refined with respect to the site infrastructure and environmental constraints. Further information is set out in Technical Appendix 3.2.

- 2.6.13 During design optimisation, the locations of infrastructure and track design were refined in order to minimise the amount of earthworks and cut and fill required to construct the Proposed Development. The extent of the three borrow pit search areas has been selected to meet the estimated volume of rock required in the construction of the proposed tracks and hardstandings.
- 2.6.14 Further intrusive geotechnical investigation would be carried out to identify the expected yield and rock quality at each of the three borrow pit locations.

Construction Compounds

Temporary

- 2.6.15 Two temporary construction compounds would be required for the duration of the construction phase. The temporary construction compound locations are shown on Figure 3.2.
- 2.6.16 The larger (main) temporary construction compound (50 m x 100 m) would be located within the southern part of the site at NGR 308075, 623220 with a smaller satellite compound (20 m x 40 m) located within the northern section of the site at NGR 307950, 624380.

Permanent

- 2.6.17 An additional Scottish Power Energy Network (SPEN) construction compound (50 m x 100 m) is required by SPEN which would be located at NGR 308035, 623340, directly north of the substation compound. This compound area would be used by SPEN during construction and then host the permanent Battery Energy Storage System (BESS) proposed at the site.

Siting

- 2.6.18 These locations are considered appropriate as they:
- have appropriate topography;
 - have limited visibility to the surrounding area;
 - are located in areas of no peat or peaty soils (less than 0.5 m deep) with negligible peat slide risk;
 - avoid sensitive habitat areas ensuring that appropriate buffers from known features would be maintained; and
 - are conveniently located where storage areas would be required.

BESS and Substation

BESS

- 2.6.19 It is proposed that a Battery Energy Storage System (BESS) (approximately 23 MW) and other electrical equipment would be located within the SPEN construction compound at NGR 308035, 623340 (approximately 100 m x 50 m), following the completion of SPEN's grid connection works. Reusing this location would avoid any additional disturbance and loss of habitat on-site.
- 2.6.20 The BESS would include 12 battery enclosures (divided into six containers) and the compound would include a water storage tank, welfare and storage buildings. The MV switchgear would be housed in the control room building.

Substation

- 2.6.21 The Proposed Development would be connected to the electricity network via an on-site substation control building and located within the substation compound (approximately 70 m x 120 m) at NGR 308050, 623285.

Siting

- 2.6.22 The locations are considered appropriate as they:
- have appropriate topography (slope);
 - are located in an area of no peat or peaty soils (less than 0.5 m deep) with negligible peat slide risk;
 - avoid sensitive habitat areas;
 - are lower down in the landscape than the wind turbines and as such less visible;

- are located greater than three wind turbine rotor diameters away from the wind turbines (for health and safety reasons); and
- can easily be accessed from the public road network.

2.6.23 The BESS and substation compound would be located greater than the topple distance from the proposed turbines. The internal site collector cables would be underground within the site from each turbine to the control building, therefore avoiding visual impact.

2.7 Micrositing

2.7.1 In order to be able to address any localised environmental sensitivities, unexpected ground conditions or technical issues that are found during detailed intrusive site investigations and construction, it is sought that the consent includes provision for a 100 m micrositing allowance for the Proposed Development.

2.7.2 The technical assessments in Volume 2, Chapters 7 to 17 of the EIA Report, have considered the potential for horizontal micrositing and it is considered that the Proposed Development could be microsited within 100 m without resulting in potential significant effects, except within watercourse buffers or where notable deep peat is identified. During construction, the need for any micrositing would be assessed and agreed with the on-site Environmental/Ecological Clerk of Works (ECoW) (definition of this role is contained in the outline CEMP (Technical Appendix 3.1).

2.8 Conclusion

2.8.1 The design process has been iterative responding to constraints identified throughout the EIA, public consultation and layout design process so that potential adverse impacts from the Proposed Development could be avoided or reduced. Potential beneficial effects through design have also been considered and enhancement of access within the site would be promoted through the creation of the new recreational heritage trail, which has been developed in consultation with the local community and landowner.

2.8.2 The final layout of the Proposed Development is described in detail in Chapter 3 and shown on Figure 3.2.

2.8.3 The assessment of the potential effects of the final layout is addressed in Chapters 7 to 17 of the EIA Report.

2.9 References

Department of Trade and Industry (1996) *The Assessment and Rating of Noise from Wind Farms*.

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