Chapter 3

Site Selection and Design

SCOTTISHPOWER RENEWABLES

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Chapter 3

3 Site Selection and Design

3.1 Introduction

1. This chapter outlines the process undertaken in selecting the Site as a potential location for a windfarm, provides a description of the Site and surrounding area, and discusses the design evolution process.

2. The principles of the EIA process, that Site selection and project design should be an iterative constraint-led process, have been followed as part of the evolution of the Proposed Development. This has ensured that potential negative impacts, as a result of the Proposed Development, have been avoided or minimised as far as reasonably possible.

3. This chapter draws on issues considered in more detail in the relevant technical Chapters (**Chapters 5 to 13**). This chapter does not repeat the conclusions of the later chapters, but rather explains how potential environmental effects have informed the design of the Proposed Development.

4. The final design for the Proposed Development is described in **Chapter 4: Development Description** and is shown on **Figure 4.1: Site Layout**.

3.2 Site Selection and Consideration of Alternatives

5. In accordance with Schedule 4 (2) of the EIA Regulations, reasonable alternatives (in terms of project design, technology, location, size and scale and characteristics) of the Proposed Development have been considered.

3.2.1 Location

6. A number of factors were considered when selecting this location as suitable for a windfarm. The predominant factors were the opportunities to use existing infrastructure which forms part of the operational Harestanes Windfarm, these include:

- use of the operational Harestanes Windfarm and forestry access tracks to access the main development area of the Site with minimal upgrades;
- a direct connection to the operational Harestanes Windfarm substation and onto the wider electrical grid system;
- re-use of existing construction infrastructure such as the construction compound and borrow pit;
- the presence of the existing operational windfarm and initial onsite wind monitoring confirms that there is likely to be a good wind resource at the Site for windfarm; and
- greater understanding and appreciation of the baseline conditions at the Site as a consequence of the construction and operation of the operational Harestanes Windfarm.

7. Other factors include:

- the Site is not subject to any international or national statutory designations;
- there are no planning policies which, in principle, preclude windfarm development.
- it has good access from the public road network particularly for longer turbine blades which allows consideration of larger turbines to make the best use of the expected wind resource; and
- the Site has no residential properties in close proximity.

8. In addition, Scottish Planning Policy (SPP) (June 2014) provides support for renewable energy development in principle and encourages local authorities to guide developments towards appropriate locations. Paragraph 154 states that planning authorities *"should support the development of a diverse range of electricity generation from renewable energy technologies – including the expansion of renewable energy generation capacity"*.

9. SPP Paragraph 155 also states that *"development plans should seek to ensure an area's full potential for electricity and heat from renewable sources is achieved, in line with national climate change targets"*. In response to these policy requirements Dumfries and Galloway Council undertook a wind capacity study (DGWLCS) (adopted 2017 with minor revisions February 2020) to identify those landscapes which, in principle, have the capacity to accommodate wind turbines. The Proposed Development is located largely within the Ae landscape unit of the Foothills with Forest (18a) Landscape Character Type (LCT). This is a large scale and gently undulating upland plateau landscape, predominantly covered with commercial forestry, attributes which increase a landscape's ability to accommodate large windfarms. The DGWLCS assesses the Ae Foothills with Forest LCT as having a medium landscape value and overall high sensitivity to very large turbine typology development (turbines of >150m to blade tip), and no capacity for new developments over 150m in height. This is explained by the reason that the "*less sensitive interior of these foothills is already occupied by Harestanes Windfarm*" and that if very large turbines "*were located in the remaining undeveloped areas of these foothills, they would be likely to incur significant and widespread effects on Nithsdale and Annandale and on other more sensitive surrounding landscapes"* (DGWLCS, section 3.4.4). DGWLCS does acknowledge that there is potential for small extensions (albeit up to 150m height) or repowering of the operational Harestanes Windfarm with larger turbines if impacts on the settled Annandale and Nithsdale, and the setting of Queensberry were considered not to be significant. These therefore are key considerations that have been taken into account with the design of the Proposed Development, noting the Site is located directly adjacent to the operational Harestanes Windfarm turbines and as an extension rather than separately sited new development.

10. The iterative design process, informed by this EIA, helps to ensure that the Site's full potential for electricity generation is achieved.

3.2.2 Technology Size and Scale

11. Onshore wind continues to be one of the cheapest forms of renewable energy; however, the challenge is to meet the Scottish Government targets within a context of limited Government support mechanisms for onshore wind, and within a competitive market which further drives technological advancement to bring costs down. The supply of smaller turbines across Europe is reducing due to lack of demand as manufacturers respond to a world market that is shifting to larger machines and focus their development work on larger turbines which secure the highest yield.

12. Larger turbines must be considered if onshore wind development is to continue to contribute to both the UK and Scottish Government's renewable energy targets. Larger turbines provide greater electricity generation than smaller turbines. Therefore, for a site to generate the same output, comparatively more smaller turbines would be required, which would require a larger site and potentially involve additional environmental effects (e.g. more turbines visible, increased footprint). Taller turbines are also more compatible with a forestry setting, as forestry through reduced impacts on forestry loss in combination with improved yield.

13. The number of turbines has been informed through the design evolution process as detailed further in this chapter, and has taken environmental as well as technical considerations into account. The rest of the infrastructure is required to enable the construction and operation of the chosen wind turbines.

14. The Proposed Development would be able to utilise the consented battery facility proposed to be installed at the operational Harestanes Windfarm Site. Other supporting technologies that are also being considered alongside this application include the provision of electric bike and electric vehicle charging points at the 7Stanes car park at Ae.

3.3 Site Description

15. The main development area of the Site is an existing commercial forest owned by the Scottish Ministers and managed by Forestry and Land Scotland (FLS). The forest is predominantly covered by Sitka spruce plantations. The topography rises to a high point of 393 metres (m) at Pumro Fell with further high points including 347m at Brownmoor Hill, adjacent to the west of the Site. The western extent of the Site is characterised by a steep valley through which the Glenkiln Burn runs north to south, whereas the eastern extent of the Site has a gentle sloping relief to a low of approximately 300m. The Forest of Ae hosts one of the 7Stanes mountain biking trail centres, with one of the trails running approximately 500m west of the Site at its closest point. There are multiple other forest tracks throughout the Site, and a section of the Romans and Reivers long-distance walking path.

16. The northern extent of the Site features the operational Harestanes Windfarm.

3.3.1 Surrounding Area

17. The surrounding area is rural, with the land predominantly used for agriculture and commercial forestry. To the north west of the operational site the landform rises to the landmark hill Queensbury. The Forest of Ae continues to the surrounding area to the west and north, while agricultural fields and rural settlements are more prominent to the east and south. The closest groups of properties to the Site are Ae approximately 2.2km to the south west and Parkgate approximately 2.6km to the south. Glenkiln is located adjacent to the Application boundary, however this is a derelict property which is owned by the Applicant and there is no intention to bring it back into residential use.

18. The A701 is located to the west of the Site and runs in a south to north west direction, and is the main transport link in the surrounding area. The remaining road network in the surrounding area comprises minor roads and tracks.

19. The closest landscape designations to the site are the Torthorwald Regional Scenic Area, approximately 6km to the south, and the Thornhills Regional Scenic Area, approximately 6km to the north west.

20. Within 5km of the Site is located one ecological designated site; Black Loch Site of Special Scientific Interest (SSSI) approximately 3.2km to the south west.

21. Operational windfarms within 10km are presented in Table 3.1 and are considered to have the most bearing on the design of the Site

Development	Number of Turbines	Approximate Distance and Direction from Site
Harestanes Windfarm	68	Within the Site and to the north
Minnygap Windfarm	10	1km to the north west
Dalswinton Windfarm	15	5km to the west southwest

Table 3-1: Cumulative Developments within 10km of the Proposed Development Turbines

22. Other windfarms, including those in planning, consented or under construction within 30km of the Site and which are considered in the cumulative assessment are illustrated in **Figure 5.8: Cumulative Location Plan**.

23. **Figure 3.1 Environmental Context** illustrates some of these features.

3.4 Design Concept and Approach

24. The identification of constraints continued throughout the design process as more detailed surveys revealed additional design influences on the Proposed Development. As a result, the findings of the technical and environmental studies have been used to inform the design of the development, and hence achieve a 'best fit' within the existing conditions of the Site. For example, where potentially significant effects have been identified, efforts have been made to avoid these through refining the design of the Proposed Development. This is referred to within this EIA as mitigation embedded in the Proposed Development layout and design, or simply 'embedded mitigation'.

25. An iterative design approach works in tandem with the EIA process and allows a receptive design process where incremental changes in layout and design result from a continually developing understanding of environmental considerations. This iterative approach allows potential environmental effects, as they are identified, to be minimised through alterations in design. Those effects which have not been mitigated through embedded mitigation are assessed in the technical chapters of this EIA Report. Further information on embedded mitigation is explained in each technical chapter of this EIA Report as appropriate.

26. 'Embedded mitigation' includes but is not limited to:

- sensitive siting of the proposed infrastructure incorporating appropriate buffer distances from environmental receptors to avoid or reduce effects on the environment;
- considering the size and scale of the Proposed Development appropriate to the location;
- considering the appearance, finish and colour of wind turbines and the control building in accordance with SNH Guidance 'Siting and Designing Wind Farms in the Landscape', V3a (SNH, 2017);
- re-using existing infrastructure as much as possible to avoid the creation of new infrastructure elements;
- design of access tracks to minimise cut and fill, reducing landscape and visual effects;
- inclusion and design of borrow pit(s) to minimise the amount of the material required to be imported to the Site; and
- potential for up to 50m micrositing of infrastructure during construction to ensure the best possible location is chosen based on site investigations.

27. Throughout the design evolution of the Proposed Development layout, a key driver has been the consideration of potential landscape and visual effects on receptors and how the Proposed Development would relate to the existing landscape character as well as existing windfarms in the landscape. In particular, regard has been paid to the scale and number of turbines proposed, cumulatively with existing windfarms in the area, in particular the adjacent operational Harestanes Windfarm. 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 of the Proposed Development and in particular to the layout design of proposed turbines.

28. In line with SNH's 'Siting and Designing Windfarms in the Landscape' guidance (SNH, 2017) and development guidance within the Dumfries and Galloway Landscape Wind Capacity Study (DGWLCS) (adopted 2017 with minor revisions February 2020) the layout and design of the Proposed Development were considered as part of the iterative design process aimed at reducing the potential landscape and visual effects of the windfarm whilst taking into account other site constraints and technical requirements.

29. It is considered that the design respects the form of the underlying landscape and its scale. Existing wind energy development is clearly a key defining characteristic of the baseline landscape and visual context, and it is expected to continue to be so for the foreseeable future.

3.5 Design Objectives

Schedule 9 of the Electricity Act 1989

30. This EIA Report has been prepared in respect of a development which will be applied for in the context of section 36 of the Electricity Act 1989.

31. The Applicant holds a Generation Licence and is required to have regard to the matters set out in Schedule 9 of the Electricity Act in formulating relevant proposals. Paragraph 3(1)(a) of Schedule 9 requires the Applicant to consider the "*desirability of preserving natural beauty, of conserving flora, fauna and geological or physiological features of special interest and of protecting sites, buildings and objects of architectural, historic or archaeological*

interest." In addition, under Schedule 9, paragraph 3(1)(b) the Applicant must "*do what he reasonably can to mitigate any effect which the proposals would have on the natural beauty of the countryside or on any such flora, fauna, features, sites, buildings or objects*". Through the EIA process the Applicant has sought to develop a scheme that takes account of the duties set out in Schedule 9 of the Electricity Act. The matters that are raised in Schedule 9 have been considered in the EIA process and the findings are presented in this EIA Report. Scottish Ministers are then required, under Schedule 9, paragraph 3(2) to assess whether the applicant has fulfilled its duties as set out in Schedule 9, paragraph 3(1).

32. Schedule 9 also sets out requirements for the protection of fisheries by generating licence holders whereby paragraph 3(3) states that "*in exercising any relevant functions each of the following, namely, a licence holder, a person authorised by an exemption to generate or supply electricity and the Secretary of State shall avoid, so far as possible, causing injuries to fisheries or to the stock of fish in any waters*." The assessment of impacts on fish is addressed in **Chapter 6: Hydrology, Hydrogeology, Geology and Soils**; **Chapter 7: Ecology**; and **Technical Appendix 7.3: Aquatic Ecology Report**.

33. The landscape and visual design strategy for the Proposed Development has taken into account and sought to balance the following objectives:

- To ensure so far as possible, the turbine layout expresses as clear and simple a form when seen in key viewpoints and one which logically relates to the character and scale of the site and its surroundings, including the operational windfarm developments in the area.
- To ensure so far as possible, that the design and layout of the turbines avoids visual complexity and confusion in key views from the surrounding landscape.
- To ensure so far as possible, a visually balanced composition of turbines is achieved within the pattern of the Foothills with Forest LCT landscape of the site area and also as experienced from the surrounding landscapes of the Foothills LCT, Upland Fringe LCT and Middle and Lower Dales LCTs.
- To take account of the various other environmental and technical constraints identified within the Site.

34. The DGWLCS provides a 'Guidance for Development' section for each LCT. The Proposed Development turbines would be located in the southern part of the Foothills with Forest LCT (18a) where it identifies that there are no opportunities for very large turbines as the operational windfarms already occupy the least sensitive interior plateau. However, the guidance acknowledges that there may be some limited scope to accommodate further turbines as extensions to the operational windfarms where that avoids the sensitive outer edges of the unit and adjacent open moorland and avoids encroaching on Queensberry hill and the rugged upland edge to the north.

35. The following list of key design objectives takes into consideration these landscape considerations and objectives from other environmental disciplines:

- retain turbines within the interior of the site (west of Pumro Hill and associated ridgeline, and north of hills in relation to Ae);
- minimise horizontal extent to fit within scale of foothills landscape;
- minimise effects on Queensberry hill as far as possible;
- use the varying topography of the site to limit height contrast with operational turbines;
- avoid the creation of distinct turbine outliers by arranging them as a coherent grouping that sits comfortably with the operational Harestanes Windfarm;
- limit the degree of turbine stacking from key receptors;
- limit proximity to closest residential receptors;
- limit impacts on priority peatland and carbon areas;
- limit impacts on known archaeological assets;
- respect other onsite environmental constraints;
- create a scheme which maximises the potential of the Site to generate renewable energy; and
- maximise the use of existing infrastructure on the Site including existing windfarm and forestry tracks.

3.5.1 Engineering Design Evolution

36. In addition to the landscape and visual considerations in the Site layout design approach, the following technical, engineering and environmental objectives were developed:

- maximise wind energy yield from the turbines as far as possible;
- avoid slopes in excess of 10% for site tracks;
- avoid areas of deep peat and known wet/boggy areas;
- reduce requirement for watercourse crossings and maintain a buffer of 50m from watercourses; and
- maintain appropriate buffers from ecological, ornithological and cultural heritage features.

3.6 Constraints Identification and Mapping

3.6.1 Overview

37. The design of any windfarm is driven by the key objective of positioning turbines so that they capture the maximum energy possible within a suitable area informed by environmental and technical factors.

38. The designations within the Site and surrounding area were identified as the first part of a constraints mapping process.

39. The known environmental and technical constraints within the Site were identified as part of the early stage constraints mapping. 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 altered appropriately. The key constraints which were considered during the design process included:

- topography;
- identified landscapes and visual constraints;
- sensitive ornithology, protected habitats and species;
- ground conditions (including peat);
- watercourses, private water supplies and related infrastructure;
- cultural heritage assets;
- location of residential properties – potential impacts on residential amenity, proximity to noise sensitive receptors, and potential for shadow flicker effects;
- aviation;
- key recreational and tourist routes;
- telecommunications links, power lines and pipelines; and
- forestry.

40. The identification of constraints continued throughout the design evolution process as more detailed surveys refined the area suitable for development.

41. 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 the technical chapters of this EIA Report.

3.6.2 Wind Analysis

42. Wind analysis and efficiency modelling has been carried out by the Applicant at key stages throughout the design evolution process to identify the areas of the Site likely to produce the most yield and ensure the commercial viability of the scheme. Wind yield calculations provided were used to establish the initial search area for potential turbine positions, the 'Developable Area' (discussed further in **Section 3.7** below). As further constraints information was

obtained and the design processed, wind analysis was again considered at each subsequent potential turbine layout.

43. For turbines to work as effectively as possible, they must be suitably spaced relative to the predominant wind direction. If they are too close together in this direction, the wake effects from the turbines located on the upwind edge of the array will create turbulent air for the next row and so on through the array. A high wake effect is disadvantageous to overall Site productivity. Conversely if turbines are located too far apart the opportunity to maximise the capacity and thereby electricity generation from the Site is reduced.

44. There is no industry standard for spacing, only manufacturer recommendations and operational experience. Referring to onsite wind measurement data the predominant wind direction at the Site was from the south west and a spacing of turbines five times rotor diameter in the predominant wind direction against three times rotor dimeter in other wind directions was applied for the Proposed Development.

45. The wind analysis has also been used to determine the location of a permanent anemometer mast within the Site. This mast would be used to independently monitor turbine performance in operation, supplemented by Lidar located adjacent to the operations building.

3.6.3 Topography

46. Whilst the majority of the Site has relatively gentle topography, the steepest areas of the Site, for example the valley of Glenkiln Burn, have been avoided for the development of infrastructure. Slopes also defined the western edge of the Developable Area.

47. 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.

3.6.4 Landscape Character and Visual Amenity

48. Potential effects on the landscape and visual resource have been an important factor in this iterative process, with both the appearance of the Proposed Development considered on its own, and its appearance within the context of the operational Harestanes, Minnygap and Dalswinton Windfarms being considered. This was carried out through the repeated testing of layout iterations as seen from agreed design viewpoint locations representing key local landscape and visual receptors around the Site (as discussed in **Section 3.7**).

49. Due to the generally high visibility of windfarms, landscape and visual aspects are particularly important, and have therefore been a key factor in the layout design from an early stage. The final turbine layout has been optimised for landscape and visual reasons as far as possible using the agreed viewpoints.

50. Where possible, the proposed excavation and location of the tracks, hardstandings. borrow pits and other infrastructure has been reviewed to minimise physical landscape, landscape character and visual amenity effects.

3.6.5 Ecology and Ornithology

51. Ecological surveys were carried out across the Site throughout 2020, including a National Vegetation Classification (NVC) Survey, protected species surveys (including bats, badger, otter, water vole, pine marten and red squirrel) and fish surveys in order to identify potential areas of constraint to windfarm development. Appropriate buffer areas were placed around these sensitive features and the design of the Site took these into consideration.

52. Surveys for potential Groundwater Dependent Terrestrial Ecosystems (GWDTE) found evidence mainly confined to areas around watercourses traversing the Site. These areas were avoided as far as possible in the turbine layout designs. As the design evolved, these areas were further investigated to establish whether they were confirmed GWDTE. Where considered to be groundwater fed, such areas were avoided.

53. Ornithology surveys were undertaken (flight activity, scarce breeding raptor, lekking black grouse, breeding nightjar, and moorland breeding bird) in order to identify potential areas of constraint to windfarm development. Appropriate buffer areas were placed around sensitive features, where identified, and the design of the Site took these into consideration. One notable species that was identified to regularly use the coniferous forestry within the Site was goshawk.

3.6.6 Peat Habitat and Depth

54. The SNH Carbon and Peatlands Map (2016) indicates that Class 5 (peaty soil; no peatland vegetation) is predominant across the Site, with Class 3 (predominantly peaty soil with some peat soil; peatland with some heath) present at the north east Site Boundary and a small area in the south west of the Site at the summit of Knockespen.

55. Peat probing was undertaken in 2020. A review of this data in conjunction with slope gradients allowed areas of deeper peat to be avoided for development at an early stage. This includes ensuring turbine locations avoid areas of deep peat.

56. The peat data is discussed in **Chapter 6: Hydrology, Hydrogeology, Geology and Soils**. As part of the Proposed Development all turbine locations, access tracks, control building and borrow pits have been designed to avoid areas which may be subject to peat slide risk.

57. Development on peatland has been largely avoided based on the peat probing data collected at the Site. Peat depth was fully considered as part of optimizing the design and in recognition of peat as a carbon sink. A carbon balance assessment has been undertaken to determine the payback period for the windfarm (refer to **Chapter 13: Other Issues**).

58. The ground condition constraints considered in the design of the Proposed Development have been:

- identification of peat depths in excess of 1.5m – to minimise incursion, protect from physical damage, minimise excavation and transportation of peat, reduce potential for peat instability and minimise potential soil carbon loss;
- identification of slope angles greater than 10˚- to minimise soil loss and potential instability; and
- avoidance of areas where initial peat stability concern was identified where possible – to avoid areas with possible instability issues and associated indirect effects on surface water.

3.6.7 Hydrology and Hydrogeology

59. A 50m buffer zone has been applied around all 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 windfarm construction best practice guidelines (SNH, 2019). This reduces the risk of run off and water pollution into existing watercourses. Watercourse and ditch crossings have been avoided in the design of the access track layout as far as possible, however where these are required they are discussed in **Section 4.2.8** of **Chapter 4: Development Description**.

60. Consideration was also given to the potential for impacts upon private water supplies. Data on private water supplies was obtained from Dumfries and Galloway Council which confirmed that there were no private water supplies within the 1km study area of the main development area of the Site.

3.6.8 Cultural Heritage Features

61. A desk-based assessment and targeted site survey provided early identification of heritage assets within the Site Boundary, which has allowed for avoidance of heritage assets in three locations. This includes the identification of the sheepfold at Clachanbirnie prior to peat probing which allowed for the location of this asset to be removed from the proposed borrow pit search area and highlighted its presence close to the edge of an existing track. Similarly, the presence of Donken's Cottage at the edge of the existing track meant that it was taken into consideration when creating access past this heritage asset. Furthermore, the presence of the Modern memorial to James Ferguson resulted in the relocation of Turbine 7 further east than the original location to reduce potential impact on the heritage asset. Retention of the small clearing within which it sits has also formed part of the design, with the proposed borrow pit to the immediate south designed to ensure there are minimal potential impacts.

3.6.9 Noise Sensitive Receptors

62. The closest noise sensitive receptor was located approximately 500m to the west of the Developable Area and approximately 800m from the nearest turbine at the Scoping stage. Noise was a consideration in relation to this

receptor during the early design stages and resulted in turbines being removed; the distance to this closest receptor now being more than 1.87km. All other noise sensitive receptors are located greater than 2.2km from the proposed turbine locations. These receptors are shown on **Figure 9.1 Noise and Vibration Sensitive Receptors**.

3.6.10 Recreational receptors

63. During the constraints identification process, the 7Stanes bike trails and Roman and Reivers core path and Long Distance Route were identified. As a result, buffers were applied during the design process to avoid operational impacts on these recreational receptors. Notably, this was a key consideration in the positioning of Turbine 1.

3.6.11 Forestry

64. As the Site is located within a working commercial forest, forestry forms an integral part of the Proposed Development as trees would be required to be felled around infrastructure positions to allow for construction of the Proposed Development. A Windfarm Forest Plan has been developed for implementation if the Proposed Development is consented. Felling and subsequent requirements for compensatory planting have been minimised as far as possible. Turbines have been 'keyholed' into the existing forestry where feasible, so that only the trees required for the infrastructure and its associated buffer zones would be cleared in general.

65. Reference to the local topography, existing forestry infrastructure, the forestry plan and maximising the use of existing windfarm infrastructure was considered in the design process.

3.6.12 Telecommunications

66. A telecommunications mast is located in the centre of the Site on Pumro Fell. From here, fixed links extend to the south and to the west. These links and the buffers associated with them were a key constraint in the design of the Proposed Development.

3.6.13 Other Factors

67. Shadow flicker has the potential to affect properties which are closer to a wind turbine than a distance of ten times the diameter of the turbine's blade length. There are no properties within 10 rotor diameters (1,500 m) from the proposed turbine locations therefore shadow flicker was not a consideration for the constraints mapping process.

68. Design has taken into consideration guidance such as Scottish Natural Heritage Guidance Good Practice during Wind Farm Construction (2019).

3.7 Design Evolution

69. The design process, as informed by the EIA, comprised six iterations to the infrastructure layout of the Proposed Development. In addition to these six main design iterations there has been additional micrositing to refine the design.

70. Changes to the Proposed Development layout were made as a result of the findings of the baseline surveys to avoid, reduce or offset the potential environmental effects, to reflect engineering constraints or as a result of comments made during consultation.

71. Three formal design workshops were held in June and July 2020 attended by members of the EIA team, design engineers as well as members from the Applicants project team. The workshops provided a forum whereby all the known constraints (including environmental) could be presented and discussed. This allowed infrastructure to be appropriately designed to maximise the viability of the development with minimal impacts on the local environment, drawing on the technical and practical experience of the project team.

72. A summary of the main layout iterations for the Proposed Development is provided in Table 3.2 below. The following figures illustrate the changes to the design as described in **Table 3.2**:

- **Figure 3.2** – design iteration of turbine layouts A, B & F (from **Table 3.2**);
- **Figures 3.3 a and b** – wirelines illustrating turbine layouts A, B & F from Viewpoint 1, located in Ae;
- **Figures 3.4 and b** – wirelines illustrating turbine layouts A, B, & F from Viewpoint 6, located south of Rashy Heights at the edge of the Southern Uplands;
- **Figures 3.5 a and b** – wirelines illustrating turbine layouts A, B & F from Viewpoint 10, located on the A701 south of the Site;
- **Figures 3.6 a and b** – wirelines illustrating turbine layouts A, B, & F from Viewpoint 16, located west of Templand, Annandale; and
- **Figure 3.7** – design iteration of associated onsite infrastructure, layouts C, D, E and F.

Design Iteration	Description
A (V1)	Scoping Layout (15 Turbines)
B (V2)	Refined Turbine Layout post Design Workshop 1 (9 Turbines)
C (V3)	Preliminary Infrastructure Layout
D (V5)	Infrastructure Layout post Design Workshop 2
E (V7)	Infrastructure Layout post Design Workshop 3 (8 Turbines)
F (V8)	Final Design

Table 3.2: Design Iterations for the Proposed Development

3.7.1 A - Scoping Layout

73. A Developable Area (the envelope which constrained the location of main wind-farm infrastructure) was initially defined, which took into consideration slope gradient, a 1km off-set from residential properties, an off-set of approximately 2km from the A701 due to visual considerations and proximity to the operational Harestanes Windfarm infrastructure.

74. Within this Developable Area, turbines were located using spacing as previously described, to maximise the number across the Site at 15. Constraints taken into consideration at this stage comprised slope gradient, watercourse buffers, telecommunication fixed links, Core Path and 7stanes bike trail buffers and initial visual consideration excluding the most obvious 'outer slopes' of the Site to the south east.

75. This layout was used for the EIA Scoping consultation stage.

3.7.2 B – Refined Turbine Layout

76. The first workshop was held to discuss the turbine layout in more detail, particularly in relation to landscape and visual considerations and wind yield, in addition to other constraints. **Figure 3.2 Design Iteration of Turbine Layouts A, B & F** illustrates the outcome of this workshop, resulting in a nine turbine layout. The rationale for this layout was as follows:

77. Turbines at the western end of the site were close to and downwind from the operational Harestanes turbines with adverse impacts on operational yield which were unacceptable, particularly turbine 2, which also had potential noise impacts to Craigshields recreation centre. Turbine 1 had visual implications for Ae and turbines 5 and 6 were encroaching on the outer slopes (or exterior) of the site and proximity to local residents.

78. The remaining turbines were re-positioned to increase separation from the operational site turbines to avoid wind yield impacts, and to optimise the site for wind yield and landscape and visual factors such as gaps, stacking, outliers, scale comparison against operational Harestanes turbines and visibility against Queensbury.

79. The position of turbine 12 was also considered in relation to preliminary peat data.

3.7.3 C – Preliminary Infrastructure Layout

80. An initial infrastructure design was proposed. Access tracks utilised existing windfarm and forestry tracks as much as possible to minimise the footprint of the development.

81. This infrastructure layout was used as the basis for more detailed ecological and peat data collection to feed into the subsequent design iterations.

3.7.4 D - Infrastructure Layout post Workshop 2

82. The infrastructure design was refined to reduce the amount of cut and fill for crane hardstandings associated with the turbines and new access tracks. Cut and fill not only has implications for use of natural materials and transport but also for visual effects and forestry loss. Track slope gradients were also reviewed to not include excessive gradients (over 10%). This is to aid the safe delivery of turbine components and associated parts.

83. The access to T7 was moved to avoid a new watercourse crossing of the Clachanbirnie Burn.

84. Initial borrow pit search areas were added and a position for a temporary power performance assessment mast/permanent anemometer mast.

3.7.5 E - Infrastructure Layout post Workshop 3

85. This layout took into consideration a number of more detailed ecological and cultural heritage considerations as more data became available.

86. Turbine 15 was moved to the east to provide an off-set to the grave site and maintain its forest clearing setting. This move was also to avoid a potential bat roost site. The borrow pit search areas were also refined and for the borrow pit near turbine 14, move to the east of the existing quarry to avoid the grave site. They were also refined to avoid a further cultural heritage asset (sheepfold at Clachanbirnie).

87. Turbine 12 was microsited to improve its position in relation to peat and mire habitat.

88. Turbine 9 was removed due to a combination of environmental and technical factors. There were visual effects due to its position on the 'outer' slopes of the Site and also in relation to extensive cut and fill requirements for this location due to the slope gradient. This region of this site also has high bat activity and therefore it was decided that this turbine be removed.

89. The construction compound was relocated to the correct position for the existing operational Harestanes construction compound, which was intended to be reused, in addition to an area of existing hardstanding at the south of the Site at Wallace's House.

90. Cable routes for power export and Supervisory control and data acquisition (SCADA) transmissions were also added at this stage, to connect the extension site to the operational Harestanes substation and control building respectively.

3.7.6 F – Final Layout

91. The changes to reach the final layout generally related to engineering updates to accommodate crane laydown hardstandings along the tracks to each turbine and changes to the access to turbine 7 due to further minimise cut and fill and slope gradients.

3.7.7 Site Access

92. It is proposed that the site access would utilise the existing access from the A701 to the operational Harestanes Windfarm, thus minimising the amount of new track required as part of the Proposed Development. Some upgrading of the existing site access would be required to facilitate the larger size of the Proposed Development's turbines.

3.7.8 Site Tracks

93. As part of the site selection factor for utilising existing infrastructure, using the existing tracks associated with FLS's commercial forestry and the operational Harestanes Windfarm was considered from the outset. This minimises impacts such as cut and fill requirements, habitat loss and the amount of felling required.

94. However, some new, or upgrade of existing tracks would be required as it is not possible to fully meet the access requirements of the Proposed Development with the site tracks in their current arrangement. As a result, at each design iteration, as described in **Table 3.3**, the areas whereby new or upgrading of existing access tracks has been updated accordingly. All access tracks have been designed to follow routes which do not include excessive gradients. This is to aid the safe delivery of turbine components and associated parts.

3.7.9 Borrow Pit Search Areas

95. Borrow pits are required as a source of rock to be used in the construction of the tracks, hardstandings and foundations. Potential locations for the borrow pits were identified based on a review of geological mapping and Site reconnaissance. The location of each was considered and refined with respect to the Site infrastructure and environmental constraints.

96. 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 total number and size of borrow pit search areas was selected to meet the estimated volume of rock required to construct the tracks, crane hardstands and foundations, although this is subject to subsequent testing of the suitability of the rock for this purpose, as noted below.

97. If the Proposed Development was consented, further intrusive geotechnical investigation would be carried out at the borrow pit locations to establish whether they would yield the required quality of rock for each aspect of the infrastructure. It is unlikely that the full areas of the borrow pits as shown on **Figure 4.1 Site Layout Plan** would be required, but this gives flexibility in case there is low yield/quality identified at any location.

3.7.10 Temporary Construction Compound

98. At the infrastructure design workshop, a potential area for the temporary construction compound was proposed east of Pumro Fell, near to Turbine 12, as illustrated on **Figure 3.7 Design Iteration of Infrastructure** Layouts C and D. This area was proposed as it was located relatively close to the site entrance and start of construction activities. However, following further investigation the location was moved further north, to a disused quarry between Holehouse Hill and Bog Shaw, which was used as a construction compound for the operational Harestanes Windfarm. Therefore, the design was updated to reflect this location, which is more suitable as it is currently flat open ground with hardstanding, the ground conditions are known to be suitable for construction compound use, and felling impacts would be avoided.

3.7.11 Control Building

99. The proposed control building has been located on land which avoids sensitive habitats areas, deep peat and steep slopes as well as being located greater than topple distance from the proposed turbines.

100. The internal site grid connection cables would run alongside new and existing tracks within the Site from each turbine directly to the operational Harestanes Windfarm substation. SCADA cables would run alongside tracks to the extension site control building before continuing to the operational Harestanes Windfarm control building.

3.7.12 Application Boundary

101. The Site or Application Boundary has evolved with the layout to ensure that all infrastructure and forestry requirements are captured within it. The final Application Boundary is illustrated in **Figure 4.1 Site Layout Plan**.

3.8 Micrositing

102. In order to be able to address any localised environmental sensitivities, unexpected ground conditions or technical issues that may be found during detailed intrusive Site investigations and construction, a 50m micrositing allowance is proposed around windfarm infrastructure. The technical assessments (presented in **Chapters 5 to 13**) have considered the potential for micrositing and it is considered that the proposed infrastructure could be micrositing within 50m without resulting in potential new environmental effects subject to it being assessed and agreed with the onsite Environmental Clerk of Works (EcoW) to ensure avoidance of local known sensitive receptors.

3.9 Conclusion

103. The final layout has been informed by a robust EIA and design iteration process, taking into account potential environmental effects, physical constraints, and health and safety considerations. The information used to inform the design iteration process has included consultation responses, extensive baseline data and the impact assessment undertaken. The final layout of the Proposed Development is described in detail in **Chapter 4: Development Description** and shown on **Figure 4.1 Site Layout Plan**. Note that for the EIA Assessment, the turbines have been re-numbered from 1-8 as illustrated in **Figure 4.1 Site Layout Plan**.

104. The principles of the EIA process, that Site selection and project design should be an iterative constraint-led process, have been followed in the design of the Proposed Development. This has ensured that potential adverse effects as a result of the Proposed Development have been avoided or minimised as far as reasonably possible.

3.10 References

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