



Chapter 2

Site Description and Design Evolution



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Chapter 2

Site Description and Design Evolution

2.1 Introduction

1. This Chapter outlines how alternatives have been considered for the proposed Development. It describes the site selection process, outlines the design evolution and describes the renewable energy technology alternatives considered. In addition, this Chapter also provides a description of the Site and surrounding area.
2. The principles of the Environmental Impact Assessment (EIA) process require that site selection and project design should be iterative and constraint-led, to ensure that potential negative environmental impacts as a result of the proposed Development are avoided or minimised, as far as reasonably possible. Schedule 4 (2) of the Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 (the 'EIA Regulations'), requires the consideration of reasonable alternatives in terms of site location and characteristics of the proposed development. Regulation 40 (2)(c) of the EIA Regulations requires that an EIA report should include (in respect of alternatives studied by an applicant): *"The main alternatives studied by the applicant and the main reasons for his choice taking into account the effects on the environment."*
3. This Chapter draws on issues considered in more detail in the relevant technical Chapters (**Chapters 7 to 15**). However, it does not pre-empt the conclusions of the later Chapters. Instead, it explains how potential environmental effects which have emerged early in the EIA and through the studies by the EIA team have informed the design of the proposed Development.
4. The final layout design for the proposed Development is described in **Chapter 3: Description of the proposed Development** and is shown on **Figure 3.1**.

2.2 Site and surroundings

2.2.1 Site description

5. The selected Site is part of the National Forest Estate and is located in the Upper Nithsdale region of the Southern Uplands, to the west / south west of the villages of Sanquhar and Kirkconnel / Kelloholm. It is mostly within Dumfries and Galloway Council's (DGC) administrative area, but with part of the Site access falling within the East Ayrshire Council (EAC) administrative area. The Site itself is centred on NGR 269180, 601990 and its location is shown on **Figure 1.1**. The majority of the Site is a commercial forestry plantation, managed by Forestry and Land Scotland (FLS).
6. The Site consists of a series of ridgelines and valleys of relatively remote uplands with forest, comprising widespread coniferous plantation and some smaller areas of open moorland. As the Site has been developed as a commercial forest, there are existing borrow pits and a network of forestry access tracks, including a main access timber haul road running north-south through the Site and forming part of the Heads of the Valleys logging route joining the A76 near Kelloholm.
7. There are a number of watercourses within the Site boundary, the most notable being Euchan Water in the northern (Euchanhead) forest block, Polskeoch Burn in the central (Polskeoch) block and Shinnel Water in the southern block (Shinnelhead). Another notable watercourse served by smaller tributaries on the Site is the Water of Ken to the west.
8. The main body of the Site is formed from several hills and ridgelines. Graystone Hill (540 m AOD) and Dalmet Hill (527 m AOD) are the prominent hills in the Euchanhead forestry block, whilst Meikledodd Hill (643 m AOD), Lorg Hill (594 m AOD) and Polskeoch Rig (536 m AOD) are the dominant hills in the Polskeoch block. In the Shinnelhead forestry block, the summit height at Wether Hill (473 m AOD) falls away slightly before building up again to Colt Hill (598 m AOD) and Lamgorrach (573 m AOD) on the southern boundary of the Site.

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9. Access to the Site is currently via three U-class roads. Access to the Euchanhead forestry block is by the U-class road U432N Blackaddie / Euchan Water Road, access to the Polskeoch forestry block is made via the U405N, an unnamed road, and access to the Shinnel forestry block is made via the U400N unnamed road. All entrances to the forest blocks are currently gated.
10. There are two proposed access routes to the Site, one of which (Access Route B) makes use of the existing access along Blackaddie / Euchan Water Road. The other proposed access route (Access Route A) uses the existing Hare Hill Windfarm access and includes a section of new access road that runs along several hillsides including Hare Hill (601 m AOD) and Blackcraig Hill (701 m AOD).
11. The Southern Upland Way runs through a central section of the Site, entering near Black Hill on the southwest corner of the Site before running north towards High Countam, and then running northeast towards Allan's Cairn. From here the path twists north before following the existing forestry road down past Polskeoch Bothy, and Polskeoch, before heading east along the U405N towards Polgown.

2.2.2 Surrounding area

12. The immediate area surrounding the Site is rural in nature with land predominantly used for commercial forestry purposes and rural agriculture. The operational Sanquhar Windfarm is located directly adjacent to the Site to the north, the operational Whiteside Hill Windfarm is located immediately to the east, and the operational Hare Hill Extension Windfarm is located approximately 1.6 km to the north west of the Site. The consented Lorg Windfarm and Sanquhar "Six" Windfarm are located immediately west and north west of the Site. An application for Sanquhar II Windfarm, which is immediately adjacent to the proposed Development, was submitted to Scottish Ministers in 2019 but has not been determined to date.
13. The ScottishPower Energy Networks South West Connections Project power line runs through the Euchanhead block from Afton Reservoir to the west in an approximately north east direction to the Glenglass substation, located to the east of the proposed Development.
14. The closest sizeable settlement is Kirkconnel, approximately 6.8 km north east of the nearest proposed turbine location, with Sanquhar being located approximately 9.8 km to the east of the nearest proposed turbine location. The nearest third party properties to the Site are individual isolated properties, including Dalgonar (approximately 1.8 km north east of the nearest wind turbine), Shinnelhead (approximately 1.9 km south east of the nearest wind turbine) and Bank Cottage / Glen Glass (approximately 2.1 km east of the nearest wind turbine) . The area immediately surrounding the Site is generally of low population density. The Polskeoch property in the centre of the Site is under SPR control and will be removed from residential use during the operation of the proposed Development.
15. One of the proposed access routes to Site, Access Route A (running south from the A76 through the existing Hare Hill Windfarm) runs through parts of the East Ayrshire Sensitive Landscape Area; however, no turbines from the proposed Development are located within this designation. The closest turbine is approximately 400 m from the edge of this (local) designation, but located within Dumfries and Galloway.
16. The closest landscape designations outwith the Site are the Thornhills Uplands Regional Scenic Area and Galloway Hills Regional Scenic Area approximately 3.2 km and 5.2 km (from the nearest turbine location) to the east and south west respectively (See **Figure 7.2**). Further afield, the Leadhills and Lowther South Lanarkshire Special Landscape Area and South Ayrshire Scenic Area are located to the north east and south west of the Site respectively.
17. There are four ecologically designated sites located within 5 km of the proposed Development (see **Figure 2.1**), which are as follows:
- Fountainhead Site of Special Scientific Interest (SSSI) –this SSSI is designated for its geological features and is approximately 120 m from the Site (4.5 km to nearest proposed turbine);
 - Polhote and Polneul Burns (SSSI) – 790 m from the Site (3.7 km from nearest proposed turbine), geological designation;
 - Muirkirk and Lowther Uplands Special Protection Area (SPA) / SSSI – 2 km from the Site (8.8 km from nearest proposed turbine), ornithological designations (hen harrier, short-eared owl, merlin, peregrine, and golden plover); and
 - Lagrae Burn (SSSI) – 3.7 km from the Site (8 km from nearest proposed turbine), geological designation.
18. There are no listed buildings or scheduled monuments within the Site.

2.3 Site selection

19. SPR uses a range of criteria to select sites for the development of renewable energy projects. As part of the growth plans for the development of renewable energy projects, SPR is continually assessing potential sites. This pipeline of potential sites is commercially sensitive and are not considered to be alternative sites to the proposed Development. Alternative sites are not considered further in the EIA Report.
20. FLS assessed their forest estate and identified potential sites for renewable energy development. In 2011, SPR was awarded the south west Scotland forest estate to further explore the potential for renewable energy to be generated on the FLS estate.
21. SPR seeks to optimise the renewable energy generation derived from its sites and therefore appraises sites for a range of potential renewable energy applications. In selecting sites, the criteria used by SPR to develop commercially viable projects include the following:
- suitable wind conditions for the installation of wind turbines;
 - solar irradiation levels;
 - potential for hydroelectric generation;
 - suitability for hydrogen production and storage;
 - availability of nearby grid connection with available capacity to accept new renewable energy generation;
 - favourable topography and access to enable the construction of projects;
 - planning policies which support the development of renewable energy;
 - avoidance of significant environmental constraints where possible on site and/ or immediately surrounding, including protected sites for conservation and heritage, protected species and their habitats and deep peatlands;
 - avoidance of the most sensitive landscapes; and
 - areas that are sparsely populated to protect the residential amenity of residential areas and households.
22. A review of the site selection requirements for the Site found the following:
- initial desk-based studies and wind monitoring onsite suggest that there is a good wind resource available at the Site to support a renewable energy development;
 - the grid network in the south west of Scotland has been identified by SPR as suited to benefit from energy storage which would complement the operation of wind turbines.
 - it has appropriate access from the public road network for construction traffic and wind turbine deliveries, particularly for longer blades which allows consideration of larger turbines to make the best use of the wind resource;
 - there are no planning policies which, in principle, preclude wind energy or renewable energy development. The majority of the Site is located within a Group 3 area on DGC wind energy spatial framework, where Scottish Planning Policy identifies that wind energy developments are likely to be acceptable subject to detailed consideration against identified policy criteria. Further information on this is provided in **Chapter 4: Climate Change, Renewable Energy and Planning Policy**;
 - whilst no longer current policy, the Site was categorised as an “*Area of Greatest Potential*” for large typology turbines in the Dumfries and Galloway 2014 Local Development Plan spatial framework. This was a key factor in why the Site was originally selected for development by SPR, and the categorisation remains relevant;
 - it can make use of the existing forestry access tracks, timber haul road and windfarm access road for Hare Hill Windfarm to minimise environmental impacts;
 - there are no international or national statutory designations for landscape and nature conservation in, or within close proximity of the Site. Whilst the Talla Hart Fell (35 km from the nearest proposed turbine location) Wild Land area, Fleet Valley (37 km from the nearest proposed turbine location), East Stewartry Coast (41 km from the nearest proposed turbine location) and Nith Estuary (35 km from the nearest proposed turbine location) National Scenic Areas fall within the landscape study area, it has been agreed with SNH¹ that due to the distances between the Site and these designations that landscape assessments on the impacts of these designations are not required;
 - it has also been agreed that the Merrick (24 km from the nearest proposed turbine location) and associated Wild Land Area does not require a Wild Land Assessment undertaken (although some aviation lighting / night-time assessment is required from key viewpoints within the designation);

¹ SNH was renamed to NatureScot on the 24th August 2020.

- other landscape designations considered in the landscape study area are the East Ayrshire Special Landscape Area that the proposed Hare Hill access route runs through, and the Dumfries and Galloway Regional Scenic areas to the east and south west of the Site. However, no wind turbines are located within either of these local designations. These designations are considered further in **Chapter 7: Landscape and Visual Impact Assessment**;
 - whilst the SNH Carbon and Peatland map (2016) shows that part of the Site has Class 1 and Class 2 peatland areas present, these areas are predominantly limited to the Hare Hill Access Route, whereas the majority of areas where turbines are proposed consist of Class 4 and Class 5 area (one turbine (T7) is located on the edge of an area mapped as Class 2 Peatland);
 - it can accommodate wind turbines and associated infrastructure without affecting sites designated for their natural or heritage interests such as SSSI, SAC, Special Protection Area (SPA) and nationally protected monuments;
 - the area surrounding the Site is predominantly rural in nature with a small number of isolated houses located in close proximity to the Site; and
 - visibility of the proposed Development from larger settlements such as New Cumnock, Kirkconnel, Sanquhar and Moniaive is either limited or entirely screened by topography.
23. Scottish Planning Policy (SPP) (June 2014) provides support for wind 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*”. 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.*”
24. In response to these policy requirements DGC has undertaken a landscape capacity study to identify those landscapes which, in principle, have the capacity to accommodate wind turbines. The Dumfries and Galloway Wind Energy Development: Development Management Considerations Supplementary Guidance (adopted 2020) (WED Supplementary Guidance) and its associated Appendix C Dumfries & Galloway Wind Farm Landscape Capacity Study (DGWFLCS), forms part of the Dumfries and Galloway Local Development Plan 2 (DGLDP2, adopted October 2019) Policy IN2, providing further detail with regards to the development management considerations identified within the policy. It provides some guidance with respect to siting and design of wind energy proposals and also the assessment of landscape, visual, cumulative and residential visual amenity effects.
25. Maps within Appendix B to the WED Supplementary Guidance identify the sensitivity of the landscape to various wind turbine typologies and are informed by the DGWFLCS.
26. The DGWFLCS provides an assessment of landscape ‘sensitivity’ for each landscape character type (LCT) identified within Dumfries and Galloway. The proposed Development is largely situated within the LCT 19a (i) Ken landscape unit of Southern Uplands with Forest which is identified as being of high-medium ‘sensitivity’ to very large (150 m+) typology turbines but of medium/low landscape value.
27. EAC have also produced a landscape capacity study, referred to as East Ayrshire Landscape Wind Energy Capacity Study, last updated in June 2018. This document aims to inform both strategic and spatial planning for wind energy and offers guidance for development through a landscape and visual sensitivity assessment for developments sited in the various Landscape Character Type within East Ayrshire. Landscape and visual ‘sensitivity’ is assessed on the host LCT’s landscape context, scale and openness, landform, land cover pattern, built environment, perceptual qualities, visual amenity and cumulative effects and is assigned an overall ‘sensitivity’ rating based on its ability to accommodate wind energy within the LCT given the sum of these factors. Whilst Access Route A is located within LCT 20a East Ayrshire Southern Uplands LCT which is considered to be of high or high-medium ‘sensitivity’ to wind turbines in this area, no wind turbines are located within East Ayrshire.
28. It is noted that both local authority landscape capacity studies and peatland mapping are undertaken at regional / national scales and thus subject to limitation as they cannot achieve the same level of definition and granularity as a site-specific impact assessment undertaken for an EIA. In particular, onsite peat surveys based on high resolution probing provides a much higher resolution mapping of peat, which allows for any deep peat areas to then be avoided as far as possible. Further detail on baseline peat data is provided in **Chapter 10: Hydrology, Hydrogeology, Geology and Soils**.

2.4 Technology, size & scale

29. The proposed Development comprises 21 three-bladed horizontal axis turbines, up to 230 m tip height, with a combined rated output estimated to be in the region of 126 Megawatt (MW) and an energy storage facility with an estimated capacity in the region of 31.5 MW. Other technologies such as ground mounted Solar Panels, Hydrogen Production and Storage, Hydro Power were considered but are not being taken forward within this development. There will be EV charging points and roof mounted solar panels installed at the control building.

2.4.1 Wind turbines

30. Onshore wind continues to be the lowest cost of new renewable energy generation and the Site has been predominantly selected for its potential to generate energy from wind turbines. Larger turbines will be needed if onshore wind development is to continue making contribution to both the UK and Scottish Government's renewable energy targets, particularly the recent announcement commitment to net zero CO₂ emissions by 2045 (Scottish Government, 2019).

31. The necessity for taller turbines is also recognised in paragraph 23 of the Scottish Government Onshore Wind Policy Statement (OWPS, 2017), which states that the Scottish Government "*acknowledge that onshore wind technology and equipment manufacturers in the market are moving towards larger and more powerful (i.e. higher capacity) turbines and that these by necessity will mean taller towers and blade tip heights*". Paragraph 25 of the OWPS continues that the Scottish Government "fully supports the delivery of large wind turbines in landscapes judged to be capable of accommodating them with significant adverse impacts."

32. It was considered that taller turbines of 150 m and above would likely provide the optimum scale of Development, subject to appropriate assessment of landscape impacts. Compared to smaller wind turbines the amount of concrete per MW produced would be less, and similarly the length of new access track (km) required per MW produced would also be significantly less. Fewer but taller wind turbines would also reduce any forestry felling by increasing the rotor clearance above the tree canopy and thereby reducing the impacts upon existing forestry operations. Taller turbines also produce more electricity as wind speed and thus energy yield increases with height above ground level. Bigger rotors also capture the wind more efficiently and produce more electricity per turbine. Broadleaf planting in some areas could be brought forward in terms of the existing Site felling plan and thus the associated benefits of this planting to biodiversity will be realised sooner.

33. The supply of smaller wind turbines across Europe is already reducing, due to lack of demand as manufacturers are recognising the world market is shifting to larger machines with development work focussing on larger turbines to secure higher yields. The onshore wind industry has experienced a reduction in supply of smaller wind turbines due to lack of demand from mainland Europe, where the tendency is to install wind turbines at higher tip heights (e.g. 180 – 250 m to blade tip). Therefore, it is highly unlikely that a range of smaller turbines (e.g. 150 m) would be available at competitive prices by the time the proposed Development is ready to be constructed.

34. Overall, whilst it was considered that taller wind turbines were the most appropriate and would better contribute to the Scottish Government's climate change targets, the assessment of landscape impacts would bear the final limiting factor on the selected height of wind turbines.

35. The final selection of the turbine tip height of up to 230 m was considered to represent the best balance of tall turbines and design in the landscape. These considerations and the final selection of turbine height are described in Section 2.5.2 Design layout evolution of this Chapter

2.4.2 Energy storage

36. There is a national requirement to balance the peaks and troughs associated with electricity supply and demand to avoid strains on transmission and distribution networks and to keep the electricity system stable. An energy storage facility is therefore proposed as part of the proposed Development to support the flexible operation of the national grid and decarbonisation of electricity supply.

37. The energy storage facility would store electrical energy through the use of batteries, contained alongside inverters (to convert the direct current (DC) from the batteries to alternating current (AC), suitable for exporting to the grid), within a self-contained building adjacent to the onsite control building to allow easy connection to the grid and minimise energy losses.

2.5 Design evolution

38. This section of the EIA Report addresses the evolution of the design that SPR has gone through from first considering the whole of the Euchanhead, Polskeoch and Shinnelhead forestry blocks to arriving at the proposed layout and scale of development.
39. This project is a result of SPR's partnership with FLS, where SPR were awarded exclusive rights to investigate the feasibility of onshore renewables projects within the National Forest Estate in south west Scotland.
40. FLS has been regularly updated by SPR throughout the design process, and has been consulted at each stage of the project. This was done through regular meetings and updates with the FLS Forest Liaison Officer. FLS also approved materials used in the Scoping exercise and public consultation.

2.5.1 Design evolution approach

41. The layout and design of the proposed Development has followed an iterative environmental constraints-led design process aimed at minimising environmental impacts but at the same time meeting the commercial requirements of SPR. An iterative design approach works in tandem with the EIA process, whereby the design process adopts incremental changes in layout and design resulting from a continually evolving understanding of environmental constraints. This iterative approach allows potential environmental constraints, as they are identified, to be avoided or minimised through alterations in design. This approach is referred to within this EIA Report as mitigation 'embedded' into the proposed Development or simply 'embedded measures'. Relevant embedded measures are explained within each technical Chapter of this EIA Report.
42. As part of the iterative approach adopted by SPR, a number of design principles and environmental measures have been implemented and incorporated into the proposed Development as standard practice, including the following:
- consideration of the form of the underlying landscape and its scale;
 - 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 and proximity to residential receptors;
 - consideration of the Site's topographical constraints and their effect on engineering design and practicality in order to ensure that the design is buildable;
 - re-using existing forestry tracks and borrow pits as much as possible to access proposed turbine locations;
 - design of new tracks to minimise cut and fill, reducing landscape and visual effects as well as costs;
 - 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 50 m micro-siting of turbines, and 100 m of infrastructure during construction to ensure the best possible location is chosen based on detailed Site investigations.
43. Throughout the design evolution of the proposed Development, a key driver has been the consideration of potential landscape and visual effects on receptors including how the proposed Development would relate to the existing landscape character as well as existing windfarms in the landscape. In particular, care has been taken to evaluate the scale and number of proposed turbines cumulatively with existing windfarms in the area, in particular with the operational site of Sanquhar Windfarm directly to the north and Whiteside Hill Windfarm immediately to the east of the Site, as well as the consented Lorg Windfarm to the south west. The landscape and visual effects potentially caused by the proposed Development have been considered extensively from key receptors during the design of the proposed Development. Consideration of the proposed Sanquhar II Windfarm, currently with Scottish Ministers for consideration, was also incorporated into the design.
44. SNH's Siting and Designing Windfarms in the Landscape (Version 3a, 2017) 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 the starting point, with the turbines spaced at minimum technical separation distances."

45. The substation and energy storage area also follow a similar physical requirement for positioning on flat land and avoiding sensitive habitats areas, deep peat and steep slopes. A number of construction and maintenance compounds are also required with similar design requirements, but taking account of practical considerations such as the requirement to be located near to the entrance and the development of the first wind turbine on entering the Site, as well as providing storage and welfare facilities across the Site.
46. The onsite access tracks have been designed to use existing forest tracks as far as possible; whilst minimising cut and fill requirements 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. All access tracks require to be designed to avoid excessive gradients to aid the safe usage of the tracks and delivery of large turbine components in particular.
47. Borrow pits would also be required as a source of aggregates to be used in the construction of the tracks, hardstandings and foundations. Borrow pit locations need to minimise construction of additional access tracks and provide easy opportunities to source suitable materials for construction. The total number and size of borrow pits has been selected to meet the estimated volume of aggregates required to construct of the tracks, hardstandings and foundations.

2.5.2 Design evolution steps

48. SPR has been investigating the potential for a renewable energy development in this area since 2011. Initially the proposed “Euchanhead” project consisted of a larger landholding covering an additional forest block (Corserig) to the north of the current Site as per **Figure 2.3**. However, following environmental surveys the Site now comprises a smaller area confined to 2,389 ha within the Euchanhead and Polskeoch/Shinnelhead Forest blocks, as shown in **Figure 2.3**.
49. SPR commissioned ecological and ornithological surveys of the original site area, which commenced in 2012. Data from these studies plus additional desk based environmental studies fed into a 31 turbine, 145 m blade tip layout that was presented in a Scoping Report submitted to the ECU in 2013. The 2013 Scoping layout included the Corserig area, and the access to the site from the A76 would have been through Corserig Forest. SPR then took some time to work on the optimisation of the project whilst considerations around access and the challenging onsite topography were considered.
50. Following a review of all work undertaken to date, in 2019 SPR refined the site area to the Euchanhead and Polskeoch/Shinnelhead Forest blocks only. The northern-most forestry block (Corserig) which is the closest to Kirkconnel and Sanquhar was removed to reduce potential visual impacts on these settlements.
51. A further direct Scoping exercise with stakeholders was undertaken in February 2020 on a revised scheme covering the Euchanhead and Polskeoch/Shinnelhead forest blocks. This featured a 20 turbine scheme, with turbines 225 m to blade tip. The scheme incorporated the significant turbine technology improvements which had occurred over the intervening period since 2013 and, with advances in energy storage technology, now incorporated an energy storage facility.
52. The proposed layout and site boundary were further refined during the EIA process as site-based surveys were carried out and following consultation with consultees, in the form of responses to the direct scoping exercise, direct consultation with consultees and discussions with the local community. Information collected during this stage of the design firstly fed into a ‘Design Chill’ layout of 20 turbines at 230 m, and two alternative accesses from the A76. The Design Chill layout enabled the EIA and SPR technical team to undertake further studies and surveys and refine further the layouts including aspects such as borrow pit locations and access track alignments.
53. Following detailed review, a final ‘Design Freeze’ or ‘application layout’ has been developed which forms the basis of this application for consent. The proposed application boundary has been revised to include the property of Polskeoch, which now forms part of the Site. As a consequence of the revision, further noise modelling has allowed the number of turbines to increase by one (to 21) between the design chill and design freeze layouts. There have also been a number of small changes including turbine location refinement in response to survey findings, alignment of roads and selection of borrow pits and substation and construction compound locations. The final design is based on a full understanding of the technical and environmental constraints. With this information, the final layout also comprises features to enhance the Site, including a Habitat Management Plan and enhanced access for recreation.
54. A summary of the evolving layouts and design, and the reasons for the changes and design decisions is presented in **Table 2.1**. **Figure 2.3** illustrates the four layouts and visually illustrates how the design and Site boundary have evolved through the design stages of the EIA process.

Table 2.1: Description of the design evolution stages

	Turbine Numbers	Tip Height	Layout Capacity	Comments and Reasons for Design Amendments
Initial layout (2013 Scoping Report)	31	145 m	77 MW	Considered to be the maximum case scenario in terms of generation using technology available at the time, whilst meeting noise and other desktop constraints. Included an additional parcel of land to the north of the Site.
1 st iteration (2020 Scoping exercise)	20	225 m	100 MW + 25 MW energy storage	The 2020 Scoping layout was informed by preliminary landscape studies and development/EIA work previously undertaken, which advised that there was scope to deploy circa 200 m tip height turbine typology on the site. Fewer, larger turbines were proposed to take advantage of advances in turbine technology and generation, but cumulative considerations also limited the capacity of the site. An energy storage facility was included on the site.
2 nd iteration (EIA studies / Design Chill)	20	230 m	120 MW + 30 MW energy storage.	<p>'Design Chill' layout which was based on the emergence of environmental constraints from baseline studies and in response to feedback from consultees and the local community. Site infrastructure was developed including options for substation, borrow pit and access track locations. Consideration of an alternative site access off the A76 was included with a view to using SPR's existing Hare Hill Windfarm access tracks as much as possible.</p> <p>Consultation with the main wind turbine manufacturers identified that a 5 m increase would significantly increase the number of standard turbine options available.</p> <p>Initial landscape advice suggested that this could be accommodated without disproportionate change to predicted L&V effects.</p>
Application layout	21	230 m	126 MW + 31.5 MW energy storage.	<p>'Design Freeze' layout which was based on the detailed examination of landscape views at key receptor locations and other detailed studies, such as habitat surveys, peat depth investigations and surveys for groundwater dependent terrestrial ecosystems (GWDTE).</p> <p>Further noise modelling following the incorporation of the Polskeoch property into the application boundary allowed an increase in turbine numbers from 20 to 21.</p> <p>Site infrastructure (access tracks and borrow pits) and locations of the substation, construction and maintenance compound and energy storage location were also amended following detailed on-site investigations and walkover surveys. This layout includes two potential access routes to the site from the A76.</p> <p>Site boundary moved north in Shinnelhead area to reflect absence of any infrastructure in this area.</p> <p>A further feature of the final layout is improving access to the Site for recreation, including proposals to improve access to the Striding Arch near Colt Hill, enhancement of archaeological features within the Site, improvements to the Southern Upland Way and the development of a Habitat Management Plan to improve modified peat habitats.</p>

2.6 Proposed consent application layout and design constraints

55. The proposed Development, which is described in detail in **Chapter 3: Description of the proposed Development**, is the result of the design evolution process described in section 2.5. This section describes in more detail how this layout and design has been determined and outlines the environmental and technical constraints which have been taken into account.

56. The key constraints which were considered during the design process included:

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

57. In order to progress the design of the renewable energy development, a 'traffic light' based constraints plan (**Figure 2.2**) was developed whereby each constraint was assigned a red, amber or green category depending on their significance. A description of how the various environmental and technical disciplines have contributed to the design through detailed assessment is set out below. Information in respect of the survey work undertaken is provided in the technical Chapters of this EIA Report (**Chapters 7 to 15**).

2.6.1 Wind analysis

58. Wind analysis and efficiency modelling has been carried out by SPR throughout the design evolution process of the wind turbines to identify the areas of the Site likely to produce the highest yields and ensure the commercial viability of the scheme.

59. 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 wind turbines located on the upwind edge of the array will create turbulent air for the next row and so on through the array, reducing overall energy output. Conversely, if wind turbines are located too far apart the opportunity to maximise the capacity and, thereby, electricity generation from a site is reduced.

60. Consideration of windfarm developments adjacent to the Site, including Lorg, Sanquhar, Sanquhar II and Whiteside Hill, was incorporated into the Site design to ensure energetic losses from other turbine proximity are minimised and that the proposed Development would not overly compromise operation of any other site.

2.6.2 Topography

61. The Site is very steep in places and use of the steepest areas of the Site (greater than 12 % slope gradient) for infrastructure has been avoided where possible. Slope stability has been taken into consideration to understand whether infrastructure could be located within certain areas of the Site. Areas where slope stability was identified as an issue were deemed to be unsuitable for infrastructure and have been avoided due to the potential for slope instability and peat slide risk.

2.6.3 Landscape character and visual amenity

62. The design of the wind turbine layout is a vital part of the landscape and visibility effects of a renewable energy development featuring wind turbines. Its appearance is considered on its own, and within the context of the surrounding immediate cumulative baseline. Landscape and visual input to the design was based on SNH's Siting and Design Guidance (2017), the DGWLCS, and baseline studies, drawing on fieldwork observations. The following key landscape and visual sensitivities were identified in the vicinity of the Site:

- potential impacts on local landscape character and regional and local landscape designations;
- potential visibility from nearby dwellings, settlements and transport routes (A76) as noted above;
- changes in the experience of recreational users on the Southern Upland Way and Striding Arches sculptures; and
- cumulative impact with adjacent operational turbines at Whiteside Hill (10 at 121.2m) and Sanquhar Community Wind Farm (9 at 130m); consented Lorg (9 at 130 / 149.9 m) as well as other proposed windfarms in the wider area.

63. The final proposed Development layout has adopted the following design measures:

- the proposed Development has been designed to be read harmoniously in the context of the nearby operational and consented windfarms. It has also been designed to take account of the adjacent proposed Sanquhar II and so fits in with the existing pattern of consented and proposed wind energy development in the local area;
- landscape context of turbines located along the windy ridges reflecting the topography and design compatibility with other operational windfarms but moved off the edge of ridge shoulders to reduce impacts on adjacent glens;
- turbines at 230 m to tip for compatibility of design with the scale of proposed Sanquhar II and ensuring the proposal is commercially viable and taking advantage of the available wind resource as efficiently as possible;
- adjustments in turbines locations to increase offset from some of the nearest residential receptors, users of SUW and those visiting the Striding Arches sculptures;
- turbines set back over 1.8 km from the closest residential properties;
- approximately half of the turbines (T3, T7, T9 -T11, T13, T14 - T16, T20 and T21) located within or adjacent to existing or planned open areas within the forestry, with most of the other locations either within forestry which has only recently been replanted or due to be felled in the next felling phase;
- visible aviation lighting mitigation to include dimming option to 200cd in good visibility and directional intensity as well as commitment to an Aviation Lighting Landscape and Visual Impact Mitigation Plan (ALLVIMP) where the final lighting specification, including mitigation, would be agreed with aviation and landscape conservation consultees / DGC prior to construction;
- the track layout makes use of the existing tracks where possible (to be upgraded for the delivery of wind turbine components), to minimise the requirement for new tracks within the Site;
- location of substation compound set partially within an old borrow pit on the edge of the forestry area to minimise effects on landscape fabric and within a visually discreet position to limit visual impacts with colour and finish of substation / control building to be visually recessive;
- new recreational features within the Site including new circular route from SUW and interpretation of cultural heritage features; and
- minimal or acceptable effects on visual amenity for nearby settlements including Kirkconnel, Sanquhar, Tyron and Moniaive, as well as the dispersed properties in proximity to the Site.

64. Where possible, proposed excavation for access tracks and other infrastructure has been minimised and the location of the substation compounds and construction compound have been adapted to minimise visual effects.

65. The landscape and visual effects of the proposed Development are addressed further in **Chapter 7: Landscape and Visual Impact Assessment**.

2.6.4 Ecology and ornithology

66. Ecological surveys have been carried out across the Site, including a Phase 1 habitat survey, a National Vegetation Classification (NVC) Survey and protected species surveys (including badger, otter, water vole, pine marten and red squirrel). Sensitive ecological features, including habitats present within the Site and species which use the Site and appropriate buffers, have been avoided. Of most significance were areas of Annex 1 peatlands and more sensitive NVC communities; these areas have been avoided where possible. In addition, the recommended habitat standoff distances from blade tip swept area to key habitat features have been incorporated into the design to reduce collision risk to bats.

67. Areas with potential to be Groundwater Dependent Terrestrial Ecosystems (GWDTEs) were also examined. They were found to be limited in extent across the Site and mainly confined to the upland moorland areas and adjacent to watercourses. Areas of high potential for GWDTEs have been avoided by Site infrastructure where possible. One area of high potential GWDTE is located close to BP07, and the proposed access track is likely to cross this area.

68. Ornithology surveys began across the Site and surrounding area in December 2012. This included vantage point watches; scarce breeding birds (for raptors, divers and any other species listed in Schedule 1 of the Wildlife and Countryside Act

1981); and winter walkovers for non-breeding birds. Top-up surveys were undertaken in the interim prior to a full suite of surveys, in line with SNH guidance, being undertaken again in 2019.

69. Following review of the survey results, SNH have agreed that the single year of surveys in 2019, in the context of the Site's relatively low ornithological sensitivity and historical data from previous years, is sufficient to inform the assessment.

70. The ecology and ornithology effects of the proposed Development are addressed further in **Chapter 8: Ecology** and **Chapter 9: Ornithology**.

2.6.5 Peat depth

71. SNH's Carbon and Peatland 2016 Map (SNH, 2016) shows the Site to be partly located within Class 1 and 2 Priority Peatland Habitat.

72. Site visits have confirmed the presence of peat and peatland habitats. However peat probing and habitat surveys undertaken in 2013 and 2020 show that the whilst peat is found across parts of the Site, it is mostly shallow peat, with areas of deeper peat being limited in distribution across the Site. Areas of deeper peat occur along on the route for Access Route A, where roads could be floated across them, Deeper peat also occurs in pockets on the central part of the Polskeoch Forest block and other shallow slope areas, but are located in forested areas where existing forestry activity is likely to have already impacted on the quality of the peat resource (**Chapter 8: Ecology**). The peat probing data is discussed in **Chapter 10: Hydrology, Hydrogeology, Geology and Soils** and **Technical Appendix 10.1: Peat Landslide Hazard and Risk Assessment**.

73. A review of the peat depth data and habitat mapping, in conjunction with slope gradients, allowed areas of deep peat (typically greater than 2.5 m) and those areas of less modified peat to be avoided where possible through the evolution of the design. Where possible, proposed wind turbines and site infrastructure would be located within areas of peat less than 1 m deep. No turbines are located within Class 1 or Class 2 priority habitat, although some sections of the proposed new access track are located within Class 1 and 2 habitats, as illustrated on the SNH Carbon and Peatland map. However, as the peat depth and quality are variable, the layout of the scheme has focused on keeping the impacts and loss of the best quality peatland habitats to a minimum. Further details of the assessment of effects on peatland habitat and habitat management proposals for restoring modified peatland habitat can be found in **Chapter 8: Ecology** and **Technical Appendix 8.8 Habitat Management Plan**.

74. The proposed Development has also been designed to avoid any areas of which may be subject to peat slide risk. The ground condition factors that were considered in the design of the proposed Development were:

- identification of peat depths in excess of 1.5 m – 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 4° - 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.

75. Further details of peat slide risk are provided in **Technical Appendix 10.1: Peat Landslide Hazard and Risk Assessment**.

2.6.6 Hydrology and hydrogeology

76. In accordance with good industry practice, a 50 m buffer zone has been applied around all watercourses and waterbodies on the Site for wind turbines and crane pads. This reduces the risk of runoff and water pollution entering watercourses. In some cases, the use of existing tracks, which are already less than 50 m to a watercourse, have been identified as the best design option for minimising the need for, more impactful, new tracks. Watercourse crossings have been minimised as far as possible; and where possible, existing crossings would be used. Existing culverts may be upgraded or replaced.

77. Publicly available data on private water supplies were obtained from DGC and identified as a potential constraint to development. A 1 km radius of the Site boundary to any Private Water Supplies (PWSs) was established. Several PWSs were located within the 1 km radius and were assessed. The proposed Development respects a 1,800 m buffer applied to PWS, where wind turbines have not been located.

78. A Private Water Supply Risk Assessment has been completed (**Technical Appendix 10.4**) and it has been shown that with the exception of a stream abstraction used for animal watering at Euchanbank (PWS01) none of the other PWS are considered at risk from the proposed Development.

79. The hydrology and hydrogeology effects of the proposed Development are addressed further in **Chapter 10: Hydrology, Hydrogeology, Geology and Soils**.

2.6.7 Cultural heritage features

80. Non-designated heritage assets were identified within the Site, which mainly relate to agricultural settlement and land division, and probably date to the post-medieval period. These features have been avoided with the inclusion of appropriate buffers as far as possible. SPR has also incorporated some of the heritage assets into the proposed Development by proposing to improve access and provide information boards for a number of features close to the Southern Upland Way, including Allan's Cairn and the Colt Hill Striding Arch.

81. The cultural heritage effects of the proposed Development are addressed further in **Chapter 11: Archaeology and Cultural Heritage**.

2.6.8 Noise sensitive receptors

82. For the purposes of early constraints mapping, avoidance buffers of 800 m were applied to third party residential properties in the vicinity of the Site. These buffers were further refined (increased) during the design process based on expert noise advice and consideration of the cumulative noise baseline. Using the background noise measurements from published data sources including other windfarm applications, 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.

83. 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 impact. Applying design criteria in accordance with ETSU guidance ensures that no exceedances of acceptable operational noise levels would occur for the proposed Development in isolation or in accumulation with other nearby built, consented or currently proposed developments.

84. The noise effects of the proposed Development are addressed further in **Chapter 13: Noise**.

2.6.9 Recreational routes

85. A number of paths and recreational routes including one of Scotland's Great Trails, the Southern Upland Way, cross or pass through the Site. A minimum standoff distance of 100 m has been applied between wind turbines and the Southern Upland Way.

86. Mitigation measures in the form of a new circular route and improved link to the Colt Hill Striding Arch have been incorporated into the operational design.

87. The of the proposed Development on recreational routes are addressed further in **Chapter 14: Socio-economic, Recreation and Tourism**.

2.6.10 Shadow flicker

88. The shadow flicker effects of the proposed Development are addressed further in **Chapter 15: Other Issues**. No shadow flicker effects are predicted as all properties are outwith the study area for shadow flicker, which is 1,550 m². All nearby occupied residential properties are in excess of 1,800 m from the nearest proposed wind turbine.

2.6.11 Forestry

89. The commercial plantations of the National Forest Estate, and FLS's existing forestry management plans for felling and planting have been considered in the design of the proposed Development. Forestry forms an integral part of the proposed Development as some trees would need to be felled ahead of currently planned plantation felling around infrastructure

² The proposed turbines for the proposed Development have 150 m rotor diameters. Shadow flicker guidance requires a study area of ten times the rotor diameter of the turbines. This would give a study area of 1,500m, plus 50 m micro-siting, for a total of 1,550 m.

positions to allow for construction of the proposed Development. A Forest Design Plan (**see Technical Appendix 3.2**) has been developed to quantify the felling and restocking requirements, as well as any residual need for compensatory planting, in compliance with the Scottish Government policy on control of woodland removal.

90. The existing felling plan is such that a large number of the turbines are able to be 'keyholed' into the existing / proposed young forestry, with only a limited number of turbines requiring older coupes to be felled. This means that out of schedule forestry felling has been kept to a minimum.

2.6.12 Telecommunications

91. Consultation with Joint Radio Company Ltd (JRC), OFCOM and BT raised no issues which could have potentially affected the proposed Development.
92. The effects of telecommunications on the proposed Development are addressed further in **Chapter 15: Other Issues**.

2.6.13 Infrastructure

93. ScottishPower Energy Networks (SPEN) have recently built a 132 kV overhead power line through the Euchanhead forestry block, as part of their South West Scotland Interconnector project. Glenglass substation was also constructed as part of this network upgrade. The Energy Network Association recommends a 3 x rotor diameter standard separation from such a powerline to prevent excessive wind turbulence. Wind turbines at the proposed Development are located closer than this recommended distance. However, computer modelling of potential wind turbulence demonstrated that turbulence would increase by less than 1%. This is not considered to be a significant amount, and has been agreed by SPEN. It is therefore considered that the turbines are located a sufficient distance from the power line.
94. An 11 kV pole mounted power line also provides power to Polskeoch, but no infrastructure is planned near this power line.
95. The effects of infrastructure on the proposed Development are addressed further in **Chapter 15: Other Issues**.

2.7 Micrositing

96. 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 proposed that 50 m micrositing around the turbine locations and 100 m micrositing around all other infrastructure is allowed. The technical assessments (presented in **Chapters 7 to 15**) have considered the potential for micrositing.
97. During construction, the need for any micrositing would be assessed and agreed with the onsite Environmental Clerk of Works (ECoW).

2.8 Conclusion

98. The EIA process has been an iterative one, so that constraints identified throughout the EIA and design process could be avoided and potential impacts of the proposed Development avoided or reduced.
99. In summary, the application design and layout represent a proposed development which achieves the following:
- maximises the renewable energy potential through the development of a mix of modern, renewable technologies;
 - minimises the proximity to and visibility from residential properties as well as the settlements of Sanquhar and Kirkconnel to the north east, Tyrnon and Moniaive to the south east and New Cumnock to the north west;
 - a layout that provides a reasonably balanced group of wind turbines when seen from key receptor locations in the surrounding landscape;
 - consideration of the cumulative landscape and visual impacts arising from the proposed Development in addition to the existing windfarms, as well as other nearby consented windfarms;
 - is largely in accordance with the Dumfries and Galloway Landscape Capacity Studies and LDP2;

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- reduces the amount of felling and can be accommodated within the Forest Design Plan for the area;
 - utilises existing forestry infrastructure as far as practicable;
 - minimises and, where possible, avoids the loss of priority habitats and species, and creates opportunity for habitat enhancement which will be delivered by a Habitat Management Plan;
 - protects watercourses from the potential impacts of constructing the Development;
 - incorporates recreational enhancements (new circular walk, improved access to Striding Arch);
 - avoids development on deep (over 1 m) peat where possible; and
 - can be engineered and constructed safely.

^{100.} The final layout of the proposed Development is described in detail in **Chapter 3: Description of the proposed Development** and shown on **Figure 3.1**. The potential effects of the resulting layout are addressed throughout **Chapters 7 to 15** of the EIA Report.

2.9 References

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ScottishPower Renewables
9th Floor
320 St Vincent Street
Glasgow
G2 5AD

T +44 (0)141 614 0451

euchanheadrenewables@scottishpower.com



SCOTTISHPOWER
RENEWABLES