3. Design Evolution and Alternatives

3.1 Introduction

3.1.1 The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 (the 'EIA Regulations') require the consideration of alternatives and an indication of the reasons for selecting the site, except where limited by constraints of commercial confidentiality. Paragraph 5(2)(d) of the EIA Regulations requires that an EIAR includes *"a description of the reasonable alternatives studied by the developer, which are relevant to the development and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the development on the environment".*

3.1.2 Part 2 of Schedule 4 of the EIA Regulations similarly notes the following requirement: *"A description of the reasonable alternatives (for example in terms of project design, technology, location, size and scale) studied by the developer, which are relevant to the proposed development and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects".*

3.1.3 This chapter provides information on how the Proposed Development site was identified by the Applicant as a suitable location for a wind energy development, as well as the design iteration process undertaken to arrive at the final development layout and design.

3.1.4 The iterative design process provides an opportunity to consider a range of environmental impacts and integrate technical and environmental considerations into the iterative design of the Proposed Development, allowing potential environmental effects to be considered, avoided and minimised. Environmental impacts are therefore considered within the Proposed Development design layout from the earliest stage.

3.1.5 The final design of the Proposed Development represented in this EIA Report was arrived at following iterative consideration of many alternative design configurations, including positioning of turbines, layout and design of tracks and ancillary infrastructure. This chapter describes the design iteration process from which the Proposed Development design emerged.

3.1.6 The final design for the Proposed Development is described in **Chapter 2: Proposed Development** and is shown on **Figure 1.2**.

3.2 Key Issues and Constraints

3.2.1 During the initial planning stages of the Proposed Development, the Applicant undertook a feasibility study which was informed by several environmental, technical and economic factors.

3.2.2 Part of the site selection and design process was to identify environmental designations and potential sensitive receptors. Key environmental issues and constraints for consideration in the site selection and design process were established through a combination of desk-based research, extensive field survey and consultation (through the EIA Scoping process and additional consultation with key consultees). The key constraints and opportunities, design objectives and actions taken are described in **Section 3.8** below.

3.2.3 The identification of key issues and constraints during the iterative process has allowed for issues to be addressed and the careful placement of infrastructure for the Proposed Development within the Site. This allowed the Applicant and EIA team to facilitate effective mitigation, with potentially significant impacts avoided or minimised as far as reasonably practicable through the design process.

Environmental Designations

3.2.4 **Figure 3.1** shows sites with environmental designations within 10 km of the Proposed Development. A brief summary of these is provided below, with full descriptions provided in the relevant technical chapters of the EIA Report.

3.2.5 There are 34 Local Nature Conservation Sites (LNCS) located within 10 km of the Site boundary:

- Dunaskin Glen / Benquhat Hill LNCS is adjacent to the west of the Site boundary;
- Doon Valley Wetlands LNCS is adjacent to the south of the Site boundary;
- Dalmellington Moss LNCS is adjacent to the south of the Site boundary;
- Benbeoch / Pennyvenie Glen LNCS is adjacent to the south of the Site boundary;
- Auchenroy / Glenmount Uplands LNCS is adjacent to the south of the Site boundary;
- Cumnock Burn / Pennyvenie Burn LNCS is situated 480 m south of the Site boundary;
- Rankinston Scub, Water of Coyle LNCS is situated 1 km west of the Site boundary;
- Dalmellington Town Common LNCS is situated 1.4 km south of the Site boundary;
- Martyrs' Moss LNCS is situated 1.5 km east of the Site boundary;
- Belston Loch LNCS is situated 2.1 km north of the Site boundary;
- Bow Burn / Ashentree Glen Wood LNCS is situated 2.2 km west of the Site boundary;

- Bryan's Height LNCS is situated 2.6 km south of the Site boundary;
- Bent Burn LNCS is situated 3 km north of the Site boundary;
- Craigs of Kyle LNCS is situated 3.2 km northwest of the Site boundary;
- Connel Burn / Benty Cowan LNCS is situated 3.3 km east of the Site boundary;
- Barlosh Moss LNCS is situated 3.4 km north of the Site boundary;
- Burnock Water LNCS is situated 3.6 km north of the Site boundary;
- Wallace Moor / Keirs Hill LNCS is situated 3.9 km west of the Site boundary;
- Dunaskin Ironworks LNCS is situated 4 km west of the Site boundary;
- Water of Coyle (Bridgend to Mill of Shield) LNCS is situated 4.6 km northwest of the Site boundary;
- Glaisnock Moss / Carnivan Hill LNCS is situated 4.7 km northeast of the Site boundary;
- Water of Coyle / Drongan Wood LNCS is situated 5.2 km northwest of the Site boundary;
- Dalgig Plantation LNCS is situated 5.8 km east of the Site boundary;
- Dumfries House LNCS is situated 6.6 km northeast of the Site boundary.
- Horsecleugh Glen Woodland LNCS is situated 7.1 km northeast of the Site boundary;
- Trabboch Wetlands LNCS is situated 7.2 km northwest of the Site boundary;
- Riggfoot / Lanemark Bogside Wetland LNCS is situated 7.3 km east of the Site boundary;
- Glaisnock Glen / Velvetere Wood LNCS is situated 7.6 km northeast of the Site boundary;
- Shankston Wood LNCS is situated 8 km northeast of the Site boundary;
- Dalleagles Woodland LNCS is situated 8 km east of the Site boundary;
- Craigengillan / Ness Glen Woodland LNCS is situated 8.4 km south of the Site boundary;
- Nith Bridge LNCS is situated 8.87 km east of the Site boundary;
- Afton Uplands LNCS is situated 9.2 km east of the Site boundary; and
- Ryderston Belt LNCS is situated 9.5 km northeast of the Site boundary.

There are seven Sites of Special Scientific Interest (SSSI) located within 10 km of the Site boundary:

- Benbeoch SSSI is adjacent to the south of the Site boundary;
- Dalmellington Moss SSSI is adjacent to the south of the Site boundary;
- Bogton Loch SSSI is adjacent to the south of the Site boundary;
- Dunaskin Glen SSSI is situated 2.6 km west of the Site boundary;
- Barlosh Moss SSSI is situated 3.3 km north of the Site boundary;
- Ness Glen SSSI is situated 4 km south of the Site boundary; and
- Nith Bridge SSSI is situated 8.7 km east of the Site boundary.

There are three Gardens and Designed Landscapes located within 10 km of the Site boundary:

- Craigengillan Garden and Designed Landscape is adjacent to the south of the Site boundary;
- Dumfries House Garden and Designed Landscape is situated 5.9 km northeast of the Site boundary; and
- Skeldon House Garden and Designed Landscape is situated 8.4 km west of the Site boundary.

There are 244 listed buildings within 10 km of the Site boundary. Here are a few notable ones:

- Dunaskin Brickworks, Waterside Ironworks, Dalmellington (Category A) is situated 3 km west of the Site boundary;
- Linn Liver Bridge, River Doon, Craigengillan (Category B) is situated 2.1 km south of the Site boundary;
- Managers House, Waterside Ironworks, Dalmellington (Category B) is situated 3.5 km west of the Site boundary; and
- Kirk of the Covenant, Knowehead, Dalmellington (Category B) is situated 1.2 km south of the Site boundary.

There is one Scheduled Monument within 10 km of the Site boundary. The King's Cairn, chambered cairn and cairn to west of Water of Deugh Scheduled Monument is situated 8.2 km south-west of the Site boundary.

Galloway Forest Dark Sky Park is situated 300 m south of the Site boundary.

Site-Specific Environmental Constraints

3.2.6 Following desk-based assessments and fieldwork in line with applicable established guidance (discussed in each technical chapter of this EIA Report), sufficient environmental baseline data was gathered to identify the environmental constraints within and immediately surrounding the Site. This information was used to inform the development of the layout of the Proposed Development through an iterative design process, as discussed in more detail below.

3.2.7 The site-specific constraints which were used to inform the evolution of the design of the Proposed Development are presented and discussed in each technical chapter of this EIA Report.

3.3 Key opportunities

3.3.1 Some of the key opportunities that were taken into account during the planning stages of the Proposed Development included the following:

- The potential to offer significant community benefits (discussed in more detail in Chapter 2: Proposed Development and the Socio-Economic Impact Report accompanying this EIA Report);
- The potential to tie biodiversity enhancement objectives in with existing habitat management plans in the area, e.g. North Kyle Energy Project, to potentially create wildlife corridors and achieve a habitat enhancement over a wider area;

- The potential to continue contributing to the restoration of surfaces in the local area which has been affected by abandoned coal mines, as is being done at the adjacent North Kyle Energy Project[1];
- The potential to offer new and enhanced recreation and access opportunities to the public during the operational phase of the Proposed Development; and
- The potential to tie biodiversity as well as access and recreation objectives in with the landowners' North Kyle Forest Master Plan[2].

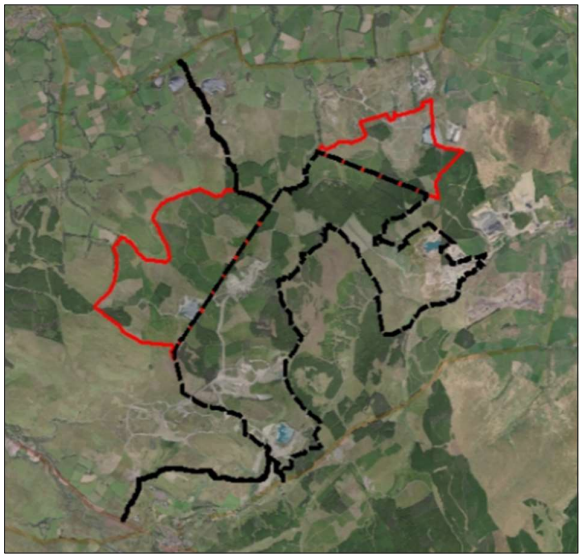
3.4 Site Selection

3.4.1 Two potential sites for the Proposed Development were initially considered. These included an area adjacent to the northeastern boundary of the North Kyle Energy Project, and an area adjacent to the west of the North Kyle Energy Project (see **Illustration 1**, below).

3.4.2 Following initial environmental constraints mapping and discussions early on in the design process, it was determined that:

- avoiding the potentially significant environmental constraints within and around the northern site would require a significant reduction in the number of turbines that could be accommodated on the site, with the result that the development would not be feasible if considered on its own in this location; and
- the western site, now referred to as the Proposed Development, was more suitable than the northern site as the environmental constraints were less restrictive and it was possible to address and / or accommodate most environmental constraints during design and still be likely to remain feasible, although this required checking at various stages of the iterative design process.

Illustration 1: Alternative sites considered



[1] https://www.brockwellenergy.com/projects/north-kyle-wind-farm/
[2] https://forestryandland.gov.scot/north-kyle-masterplan

3.5 Consideration of Alternatives

3.5.1 Paragraph 5(2)(d) of the EIA Regulations requires that the EIA Report includes a description of reasonable alternatives studied by the developer, which are relevant to the development and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the development on the environment.

3.5.2 As noted in Planning Advice Note (PAN) 1/2013, *"Whilst the Directive and the Regulations do not expressly require the applicant to study alternatives, those alternatives which are in any case considered as part of the project planning and design process must be assessed, and an outline of the main alternatives studied by the applicant included in the EIA Report. The EIA Report must also give an indication of the main reasons for the choice made, taking into account the environmental effects".*

3.5.3 The Applicant has considered a number of alternative turbine layouts for the Proposed Development, as outlined in **Section 3.7**. The finalised layout represents the 5th key design stage iteration since the commencement of the project. However, further minor iterations were undertaken in between the key stage iterations, resulting in a total of 13 iterations having been undertaken altogether.

3.5.4 The primary alternatives considered during the evolution of the design of the Proposed Development included:

- "Do nothing";
- Alternative designs;
- Alternative turbine parameters;
- Alternative materials management strategies;
- Alternative access routes;
- Alternative forestry impact management strategies; and
- Potential biodiversity enhancement options.

Do Nothing Scenario

3.5.5 In the absence of the Proposed Development, it is anticipated that the current land uses within the Site would continue as determined by the landowners. While this would mean no anticipated adverse environmental impacts arising due to the construction and operation of the Proposed Development, the do nothing scenario would also mean that:

- the proposed community benefits to be derived from the operation of the proposed wind farm would not be realised;
- there would be no contribution to national net zero targets;
- there would be a loss of the expected beneficial impacts of the Proposed Development including biodiversity enhancement;
- the further restoration and remediation of the former derelict mining land within the redline (around Coyle Water predominantly) would not be delivered; and

- the improved access which would be the only access controlled fully by FLS which would provide the most appropriate and viable public access right into the NKF would also not be realised.

3.5.6 In addition, the potential for the Proposed Development to contribute to the overall objectives of the Applicant and land owners to restore the landscape that has been damaged and left derelict as a result of abandoned opencast and underground coal mines and related infrastructure, would be lost.

Alternative Designs

3.5.7 The Proposed Development has been revised numerous times in response to various factors, including:

- environmental constraints information derived from desktop studies followed by site investigations;
- pre-application consultation responses received from consultees;
- feedback gathered during the pre-application public consultation events; and
- technical design constraints associated with the proposed infrastructure to be utilised.

3.5.8 **Figures 3.2** to **3.4** and **Figure 1.2** present the layout at key stages of the design process. These key-stage layouts are discussed in more detail in **Section 3.7.**

Alternative Turbine Parameters

3.5.9 The potential choices of available turbines that would enable the aviation constraints on the Site to be accommodated are very limited due to the height restrictions relating to the required turbine 'headspace' and aviation 'ceiling', which limited the choice of turbines to 149.9 m to tip height turbines.

3.5.10 The other major factor influencing the choice of turbine parameters to be used in the design of the Proposed Development was the location of the Site adjacent to the North Kyle Energy Project which consists of 49 turbines of 149.9 m in height. Using the same turbine parameters as those at the adjacent North Kyle Energy Project would minimise potential visual impacts which would likely arise if turbines of a different height were to be used at the Proposed Development.

3.5.11 The use of turbines of lower height dimensions was considered for particular turbines where aviation constraints were of concern, but this was dismissed as a potential option since the preferred turbines could be sited lower down the slope and still produce an acceptable energy yield.

3.5.12 In addition, the use of turbines less than 149.9 m was considered but dismissed as a potential option as the energy yield would not have been viable and in addition

because there are no models in that size range produced by Tier one suppliers and hence the choice of such turbines would have rendered the scheme as unviable.

Alternative Materials Management Strategies

3.5.13 The two main materials management considerations during the design stage included:

- Track construction material sources; and
- Peat management options.

3.5.14 Three main options were considered for sourcing track construction materials, namely:

- Using on-site borrow pits, assuming suitable material is present and accessible within the site in sufficient quantities; or
- Importing construction material to the Site; or
- A combination of the above.

3.5.15 The preference from a practical perspective is to source suitable material from on-site borrow pits where possible, as this has several benefits relating to minimising distances over which construction materials require transportation, which minimises construction time as well reducing the carbon footprint of the construction phase of the development. Six potential borrow pits were initially identified, but due to other influencing factors such as environmental constraints, engineering constraints and more difficult accessibility, only three borrow pit search areas have been brought forward into the design of the Proposed Development.

3.5.16 However, should insufficient material be available, track construction material will be required to be imported to the Site. The main option considered for this is to import suitable aggregate from existing borrow pits on the North Kyle Energy Project site, subject to agreement with the operators and any required permissions.

Peat Management Options

3.5.17 Due to peat being present over most of the Site, it is expected that peat will be required to be extracted during construction, which will need to be managed. Two main options are under consideration including:

- reusing the peat in appropriate locations on Site (locations for reuse will tie in with the outline biodiversity enhancement plan where possible); or
- exporting extracted peat to the adjacent North Kyle Energy Project to augment the land restoration that is being undertaken there, or
- a combination of the above.

3.5.18 The peat management options have been discussed and the proposed strategy presented within **Chapter 8: Geology, Hydrology, Hydrogeology and Peat** and the outline Peat Management Plan (**Technical Appendix** 8.2).

Alternative Access Routes

3.5.19 Due to the location of the Site, and the agreement that is in place between the Applicant and the North Kyle Energy Project, the consideration of alternative access routes was not necessary. However, should an alternative access route be required for any reason, this would likely be from the west or north of the Proposed Development, and would depend on several factors including any agreements to be made with the landowners along the access track and with the landowners of the Site, as well as environmental constraints and the requirements for abnormal indivisible loads (AIL).

Alternative Forestry Impact Management Strategies

3.5.20 Two main strategies have been considered regarding management of impact on the commercial forestry within the Site:

- Clear felling within the development area; or
- Keyhole felling.

3.5.21 Due to the relatively low height of the turbines and the proposed rotor diameter, the clearance of the bottom sweep of the blades above the ground is minimal and would not accommodate forestry beneath the turbines. This will necessitate the removal of trees to facilitate the construction and operation of the Proposed Development. From a wind resource perspective, it may be necessary to clear fell areas of forestry to optimise energy yield, and in other locations it would be appropriate to limit adverse impacts on forestry through keyhole felling. The felling strategy is discussed in **Chapter 9: Forestry**.

Potential Biodiversity Enhancement Options

3.5.22 Various biodiversity enhancement options are under consideration and are discussed in the Outline Biodiversity Enhancement Management Plan (OBEMP) (**Technical Appendix 6.6**). It is the intention for the options to align with several objectives, including:

- Compliance with relevant legislation and guidance;
- Current and potential habitat conditions on the Site;
- Landowner requirements and preferences (where possible); and
- Potential to create links with habitat enhancement areas within the North Kyle Energy Project.

3.5.23 The overall objective of the OBEMP will be to deliver a clear biodiversity net gain of 25 %.

3.6 Design Evolution of the Proposed Development

Design process

3.6.1 The design of the Proposed Development was iterative and guided by the EIA process. Baseline information gathered from desktop studies and field surveys was continuously incorporated into the design at various stages. This approach facilitated key decisions that resulted in the primary mitigation of as many potential environmental impacts of the Proposed Development as possible.

Design Principles

3.6.2 The overarching principles guiding the design of the Proposed Development aimed to maximise renewable energy generation while:

- Minimising the land disturbance needed for constructing the wind farm infrastructure as much as possible;
- Reducing potential impacts on sensitive receptors wherever possible;
- Minimising the number of necessary watercourse crossings to the greatest extent practicable;
- Applying the waste management hierarchy, such as reusing materials on site rather than removing and disposing of them in landfill; and
- Identifying potential opportunities for environmental enhancement, access improvement and community benefits.

Design Objectives

3.6.3 The final Proposed Development layout has been informed by a robust design iteration process, considering potential environmental, landscape and visual impacts and their effects, physical constraints, safe and efficient operation of the development, and health and safety considerations. The information used to inform the design iteration process included baseline data (desk studies and field surveys), review of preliminary visualisations, ongoing impact assessments and consultation feedback.

3.6.4 The Proposed Development layout is considered to represent the most appropriate design, considering acceptable limits for potential environmental impacts and physical constraints, while maximising the renewable energy generating capability of the Site and maintaining financial viability of the Proposed Development.

3.6.5 Key design considerations and drivers for change throughout the design iteration process are summarised in **Table 3.1**, below. The iterative design process was environmentally led, and was primarily influenced by:

- aviation constraints due to the relatively close proximity of the Site to the Glasgow Prestwick Airport and situation within a MOD low flying zone;
- residential amenity of residential properties in relatively close proximity to the Site;
- presence of peat deeper than 0.5 m over a large portion of the Site;
- hydrology;

- ecology; and
- ornithology.

3.6.6 Other major considerations driving the design and layout of the Proposed Development included sustainability principles such as:

- reusing existing infrastructure wherever possible;
- minimising infrastructure footprint and potential impacts on sensitive environmental receptors; and
- identifying potential opportunities to enhance biodiversity.

3.6.7 Furthermore, the potential to impact on the current land use was taken into consideration during design, with the decision being taken to minimise potential impacts on commercial forestry and grazing.

3.6.8 The overall design objectives were to maximise the renewable energy yield, while minimising potential adverse impacts on the receiving environment, while also identifying opportunities to enhance the natural environment and benefit the local communities.

Table 3.1: Key Environmental Design Objectives

Aspect	Sensitive Receptors	Constraints / Considerations	Design Objective	Actions / Decisions Taken
Aviation	Glasgow Prestwick Airport	FAVA line	Avoid FAVA line entirely, turbines to be sited west of the FAVA constraint buffer.	All turbines sited south of the FAVA line, with the closest turbine sited 60 m away.
		IFP procedures	Turbine heights to be below aerial height restrictions relating to IFP procedures.	• Turbines restricted to 149.9 m. • Where necessary, turbines were sited on lower topographical lines to avoid tip heights above the aerial overhead constraint. • Impacts on IFP's were considered from the outset in the initial layout and have been iterated and refined to identify a turbine layout that minimises such impact and restrict changes to minor amendments to IFP's that are considered by the Applicants advisors to not present any material operational impacts on GPA. These changes were socialised with GPA at the earliest stage of design. The Applicant recognises that GPA has fully reserved its position subject to more detailed analysis and consideration.
Residential Amenity	Residential properties within 1.5 km of the Site	Likely visual effects, noise levels, potential to affect private water supplies	To take account of potential visual amenity effects of turbines on the nearest residential properties.	• Siting of western-most turbines at least 1 km away from residential properties, taking likely financial involvement of properties into account. • Wireline visualisations from the nearest properties were checked at key stages in the design iteration process to obtain an initial understanding of potential residential visual amenity effects.
			To take account of likely effects of noise on the nearest residential properties	Noise baseline monitoring was undertaken followed by noise modelling based on a candidate turbine to inform noise levels and therefore siting of turbines, where applicable. Financial involvement of the

Aspect	Sensitive Receptors	Constraints / Considerations	Design Objective	Actions / Decisions Taken
				closest properties also informed the likely noise limits that were applied to the modelling.
			To avoid the potential to affect private water supplies (PWS) within the study area.	Locations of PWS were established through desk study, field surveys and consultation of residents within the PWS study area. Turbines and tracks were sited outside of catchments feeding PWS supplies wherever possible.
Peat	Peat	Peat depths.	To avoid peat deeper than 0.5 m wherever possible, however, because most of the Site is covered in peat deeper than 0.5 m, a pragmatic approach was applied to keep infrastructure, particularly turbines, out of deeper peat and on shallower peat.	• Phase 1 and Phase 2 peat probing informed the design iterations and was one of the main drivers for change at key stages of the design iteration. • Significant effort was made to site turbines and related infrastructure on the shallowest peat possible, while also taking other constraints into consideration such as hydrology and ecology constraints.
Hydrology	Watercourses and water bodies	Locations of watercourses and water bodies.	To minimise potential impacts on sensitive receptors.	• An exclusion zone was applied to the Coyle Water, as required by the landowner. • A 50 m avoidance buffer was applied to all watercourses and water bodies (except where existing infrastructure was already located within the 50 m avoidance buffer, e.g. the existing mining track travelling closer than 50 m to the Coyle Water). • A 250 m avoidance buffer was applied to all PWS. Furthermore, an assessment of PWS source catchments was undertaken, and infrastructure was sited outwith these areas. • The number of new required watercourse crossings was minimised.
Ecology & Ornithology	Important Ecological Features	Appropriate avoidance buffers were	To avoid sensitive habitats and protected species wherever possible,	• Turbines and ancillary infrastructure were sited outside of sensitive habitats wherever possible,

Aspect	Sensitive Receptors	Constraints / Considerations	Design Objective	Actions / Decisions Taken
	e.g. sensitive habitats, protected species, etc.	implemented for various IEFs	and to minimise the potential to impact on IEFs through design.	and where this was not possible, the footprint of the infrastructure within these habitat areas was minimised. • Potential of the infrastructure to impact on protected species was avoided wherever possible. • Potential options for biodiversity enhancement and mitigation were considered throughout all stages of the design process.
Cultural Heritage	Heritage assets & settings	Heritage assets within the Site were avoided through implementation of appropriate avoidance buffers.	1. To avoid direct impacts on known heritage assets within the site. 2. Where applicable, to avoid potential significant impacts on the settings of important heritage assets outwith the Site that may be affected by the Proposed Development.	• Infrastructure was sited away from known heritage assets, except for where existing infrastructure (access track) is located close to a heritage asset. However, there are no visible remains of the asset, it is not anticipated that any required track upgrade work would impact on the asset, and as such, was not a significant concern during design. • No specific action was taken to minimise potential impacts on settings of heritage assets outwith the Site, due to a combination of a lack of nationally important assets in the local area (none were identified by HES at Scoping stage) as well as the likelihood that sensitive siting of the turbines, and the relatively low height of the turbines, would also minimise potential impacts on any cultural heritage assets of concern. Refer to **Chapter 10: Cultural Heritage** for further information.
Forestry	Commercial forestry, both on Site and within the wider NKF Estate.	Landowner preference to continue commercial forestry within the Site.	To minimise felling of trees that would be undertaken outside of the forestry management felling plan.	• Where topography permitted, decision to restrict the standard area of land sterilised for forestry to a 100 m radius around the turbine was taken. • Where topography was more challenging, and an area greater than 100 m radius was

Aspect	Sensitive Receptors	Constraints / Considerations	Design Objective	Actions / Decisions Taken
				required, a design process, informed by wind flow models was used to minimise the amount of ground that was proposed to be sterilised. • Any additional felling required for wind resource maximisation was minimised as far as possible and will be agreed with the land owner as part of the Forest Management Plan. • A 15 m felling buffer from the edge of all infrastructure (including all tracks) has been assumed.
Land Use	Landowners including commercial forestry operators and livestock farmer.	Landowner requirements	3. Avoid the Coyle Water area to protect that for future public amenity and the location of a potential visitor centre/hub; 4. Minimise adverse impacts on commercial forestry; 5. Tie in with landowner long-term biodiversity enhancement and forestry management plans where possible; 6. Provide screening of the BESS and substation by ensuring trees are planted / present between the BESS and substation, and the access track.	• Establishment of an exclusion zone around the Coyle Water. • Identification of potential biodiversity enhancement options taking landowner requirements and preferences into account. • The screening of the BESS and substation facilities is a mitigation objective of the Proposed Development and will be implemented taking BESS fire safety guidance into account.
Public Access & Recreation	Recreational users and local communities	NKF Master Plan, particularly the objectives relating to making the area more accessible to local communities and recreational visitors.	1. Providing access road, walking and cycling access to the Site for recreational use during the operational phase; 2. To restore land that was left derelict by past mining activities;	• No specific action taken, as the objectives of the Proposed Development design relating to other environmental aspects will simultaneously address this objective. • In addition, the Applicant is funding the investigation into the feasibility and design of a visitor centre/hub in conjunction with the

Aspect	Sensitive Receptors	Constraints / Considerations	Design Objective	Actions / Decisions Taken
			3. Identifying potential opportunities to enhance recreational appeal and encourage visitors to the Site; 4. Ensuring the health and safety of all visitors to the Site.	Landowner, local community council representatives and the LPA. • The design of the community benefit package is being discussed and refined to allow the first ten years of benefit monies to be made available at the project's financial close to fund the visitor centre/hub in the vicinity of the Coyle Water. • For the avoidance of doubt, the Visitors' Centre would be subject to a separate planning application. • The intentions of the Applicant in this regard, and the potential community and recreational access benefits were presented at the public consultation events that were held in 2024 (see the accompanying standalone PAC Report for more detail).

Other key design objectives that shaped the Proposed Development included technical and economic considerations, which are summarised in **Table 3.2** below.

Table 3.2: Key Technical and Economic Design Objectives

Aspect	Design Objective	Actions taken
Wind resource	To maximise energy yield of each turbine.	• Turbines were initially sited to maximise yield on the Site and spaced appropriately to maximise use of wind resource and maximise yield. The turbines require minimum separation distances, referred to as separation ellipses. • The wind resource of the Site was analysed and used to inform the suitability and wind resource optimisation of each turbine. While this was a major consideration, key environmental constraints such as peat depth and hydrology avoidance buffers took precedence over wind resource maximisation.
Engineering	To ensure the design: • Is 'buildable';	• Tracks were aligned to follow existing tracks and contour lines wherever possible.

Aspect	Design Objective	Actions taken
	• Meets turbine manufacturer and DNO specifications; • Minimises the need for engineering works such as 'cut and fill'; • Took environmental constraints and wind resource requirements into account.	• Turbine manufacturer requirements for ancillary infrastructure such as tracks, AIL turning heads, turbine hardstands, crane hard stands, substation and fire safety etc. were taken into account. • Construction compounds and laydown areas, borrow pit search areas and other infrastructure such as a BESS facility and substation were included in the design. • Each relocation of turbines, tracks and other infrastructure was checked for compliance with engineering requirements, standards and specifications to ensure the final design will be buildable. • Considered potential alternative locations or orientation of infrastructure to minimise impacts on environmental sensitive receptors.
Generating capacity	To design a wind farm with a generating capacity of at least 80 MW to meet grid connection requirements.	Planned for 20 turbines taking environmental and technical constraints into account, that would deliver 90 -100 MW of nameplate capacity, which when combined with the proposed BESS would likely make optimal use of the available 80 MW grid connection on the site.
Stability of electricity supply	To provide infrastructure to facilitate a stable supply of electricity to the grid to assist in meeting peak demands.	Included a BESS in the design to provide stability of supply to the grid should the need arise and minimise any curtailment.
Economic viability	To take account of environmental and engineering constraints but still remain financially viable.	The continued financial feasibility was checked regularly using applicable software during the iterative design process to ensure that the Proposed Development remained financially viable. The BESS was added to the initial design as an option to help improve projected future returns.
Health and Safety	To take account of recorded mine entries and other mining related infrastructure and implement an appropriate avoidance buffer.	A 100m avoidance radius was applied to the mine entries on record (provided by the CMA during Scoping).
	To minimise the impacts of a potential catastrophic event e.g. toppling of a turbine.	All infrastructure will be sited at least 149.9 m + 10% (164.89 m topple distance) from the proposed turbine locations, with the exception of the sections of track providing access to the turbine.
	To take account of BESS fire safety guidance.	A 10 m avoidance buffer was established around the BESS footprint area to act as a fire break.
		To provide two accesses to the BESS site for fire fighting access, and to make provision for fire fighting requirements such as a fire water provision and management system.

Aspect	Design Objective	Actions taken
	To comply with CDM Regulations.	Compliance of the design was checked at key stages against the CDM regulations by an appropriately qualified and competent civil engineer.

3.7 Design Iterations

3.7.1 The layout of the Proposed Development was an iterative process which started in January 2024, each time taking into consideration information gathered through site assessments or comments from consultees, as well as the professional judgement of technical specialists.

Following the submission of the EIA Scoping Report and the receipt of the EIA Scoping Opinion, the Applicant undertook design iterations to maximise the capacity of the Proposed Development and beneficial environmental impacts while minimising the potential adverse environmental impacts.

Layout A: Initial Layout (January 2024)

3.7.2 The initial layout of the Proposed Development was developed taking available information into account, including the following:

- Technical requirements such as separation ellipses and wind resource information;
- Landowner requirements (e.g. applying an exclusion zone to the Coyle Water area);
- Known aviation constraints (e.g. FAVA line);
- Designated conservation areas including Sites of Special Scientific Interest, Special Conservation Areas, Special Protection Areas, Ancient Woodland, etc.;
- A 2 km settlement avoidance buffer;
- Phase 1 peat probing depths and interpolation;
- Exclusion zone from the North Kyle Energy Project turbines;
- Coal mining risk assessment findings; and
- Watercourses mapped on 1:50,000 OS mapping.

3.7.3 Due to some early survey work and engagement with key consultees, and from experience gained and data generated during the development of the North Kyle Energy Project, it was possible to develop an initial layout that not only took the technical requirements of the turbines into account, but also some initially identified environmental constraints. The main objectives of the design at this early stage were to:

- Avoid deeper areas of peat;
- Avoid locating turbines near watercourses;
- Avoid the FAVA line;
- Establish an oversail buffer along the red line boundary;
- Establish the Coyle Water exclusion zone; and
- Take cognisance of the separation ellipses of the turbines.

3.7.4 At this stage, only turbine positions were identified. This layout consisted of 26 turbines within a Site area of 851.2 ha.

Layout B: Scoping Layout (April 2024)

3.7.5 A pre-scoping design workshop was held with environmental specialists in attendance. The purpose of the workshop was to use available information to refine the initial design to take account of environmental constraints and technical requirements.

3.7.6 At this stage, environmental information was limited to desktop studies, and to the surveys that had been done prior to scoping which included Phase 1 peat probing and ornithology surveys. Various constraints, including watercourse buffers, gradient limitations, and abnormal load access requirements, influenced turbine placement.

3.7.7 Some initial design advice was provided by the environmental specialists, and included the following (in addition to the environmental constraints that had previously been applied in the initial layout (Layout A)):

- An initial avoidance buffer was applied to individual residential properties to provide an indication of potential for residential amenity effects (predominantly visual and noise);
- Relocating turbines to avoid peat deeper than 0.5 m where possible, or where this was not possible, to locate on peat indicated to be between 0.5 m and 1 m deep. This was done with the knowledge that Phase 2 peat probing would further inform the positions of the turbines at a later stage;
- All turbines were located outside of the 50 m watercourse avoidance buffers, although there were some hardstands that were partially within the 50 m watercourse avoidance buffers but outside of the 10 m minimum avoidance criteria of The Water Environment (Controlled Activities) Regulations 2011 (as amended). Wherever possible, these were relocated to avoid the 50 m buffer, and in some instances were reoriented to avoid entering the avoidance buffers; and
- There was one cultural heritage asset within the Site (a medieval farmstead), directly adjacent to an existing track, with no visible remains on the surface. Any changes to the track would need to be made to the opposite side of the track to avoid impacting on the heritage asset.

3.7.8 Other considerations which influenced the positioning of the turbines included angle of the slopes, with a view to potential access tracks and required cut and fill, as well as required cut and fill for infrastructure such as the permanent hardstands and temporary crane hardstands. Further considerations included minimum radius requirements of the bends in the access tracks to accommodate the Abnormal Indivisible Load (AIL) vehicles.

3.7.9 Some examples of how the consideration of the environmental constraints and engineering requirements influenced the evolution of the initial design include:

- T7 was adjusted westward to move out of the 50 m watercourse avoidance buffer;

- T11 required minor repositioning southward to prevent encroachment into a sensitive habitat area;
- Hydrological and gradient constraints required further assessments, particularly for T17 and T20;
- T18 and T20 were moved to avoid requiring additional watercourse crossings; and
- T19 would potentially be relocated to enable the utilisation of an existing track (rather than creating new track), although this was subject to an aviation constraint check.

3.7.10 Once the design had been revised following the workshop, the design was further optimised for energy yield and rechecked against the environmental constraints before being finalised. This process resulted in the production of **Layout B: Scoping Layout**, presented in **Figure 3.2**. At this stage, only turbine positions were identified, as the locations of the access tracks and other ancillary infrastructure would be informed by further baseline survey work. This layout included 26 turbines. No changes were made to the Site boundary.

Layout C: Addition of Land (September 2024)

3.7.11 Following the establishment and refinement of site-specific baseline data through field surveys and further background studies, more detailed information was available to further inform the design. Due to aviation constraints, residential amenity concerns, partial location of ancillary infrastructure (e.g. turbine hardstands) within the 50 m watercourse avoidance buffer, ecological constraints and constructability requirements, ten turbines were removed from Layout B: Scoping Layout.

3.7.12 However, this reduced the energy yield of the Proposed Development to 72 MW, which was below minimum feasibility levels and also well below the agreed grid supply of 80 MW. To offset the reduction in capacity and feasibility, additional land was acquired adjacent to the Site, which was subsequently added to the Site boundary. The area of the Site boundary consequently increased to 1,004.32 ha. Four new turbines (referred to as P01 to P04) were introduced within the newly acquired land, increasing the total number of turbines to 20 which would be capable of producing up to 100 MW.

3.7.13 It was at this stage that ancillary infrastructure was added to the design, including:

- Access tracks;
- A compound to accommodate a battery energy storage system (BESS) of up to 40 MW;
- A construction compound;
- A substation compound; and
- A borrow pit search area.

3.7.14 The substation and BESS were incorporated into the design at a suitable location to enable efficient connection to the grid. The construction compound was strategically sited taking peat depths, ecology and terrain constraints into account

as well as a location that was suitable in terms of practical construction requirements. A borrow pit search area was identified based on available information**. Layout C: Addition of Land** is shown on **Figure 3.3**.

Layout D: Design Chill (November 2024)

3.7.15 Following the development of Layout C, where necessary, work was undertaken to establish baseline environmental information on the additional land that had been incorporated into the Site. As with each previous iteration, key constraints included aviation, residential amenity (visual and noise), peat depths (based on Phase 1 peat data interpolation), mine entries, ecological and hydrological constraints. Engineering requirements such as gradients, turning radius, cut and fill requirements, etc. were also considered. Furthermore, impacts of changes to the design on energy yield were also checked. This process allowed the design to be optimised from environmental, technical and economic standpoints.

3.7.16 Turbines T1, T2, T5, T9, T12, T14, T19, and T23 were repositioned to avoid areas of deeper peat, although the relocation of T12 was further constrained predominantly by ecological factors. T1 was relocated northward to improve the earthworks footprint, with a graded track leading to the permanent hardstand.

3.7.17 The hardstand for T18 was reoriented to move it out of deeper peat, while avoiding the North Kyle Energy Project separation buffer.

3.7.18 Adjustments were made to the access track to T20 to avoid a mine entry buffer.

3.7.19 Turbine hardstands for the four new turbines (P01, P02, P03, and P04) were adjusted to improve earthworks requirements and minimise environmental impacts, most notably being adjusted to move off areas of deeper peat. T21 was relocated to optimise energy yield while avoiding the mine entry buffer.

3.7.20 P02 was moved to improve separation from P01 and to move it off an area of deeper peat. The substation and BESS were adjusted to improve track gradients and mitigate peat disturbance. A second construction compound was added north of T10 to accommodate construction requirements.

3.7.21 This layout consisted of 20 turbines. The Site boundary was expanded slightly further to accommodate moving turbine P01 further northwards, increasing the area of the Site to 1,011.82 ha. The expansion of the red line boundary included land owned by another land owner. **Layout D: Design Chill** is shown on **Figure 3.4**.

Layout E: Final Design (March 2025)

3.7.22 Following Design Chill, Phase 2 peat probing was conducted in areas where infrastructure was proposed to be located. In addition, reconnaissance walkovers were conducted for hydrology, geohydrology, private water supply (PWS), and borrow pit search areas, with the result that more detailed baseline environmental

information was available to inform the refinement of the design. Using this information, the layout of the Proposed Development was revised as follows:

- T2 was moved further north to avoid deeper peat and higher value habitat, while maintaining the oversail buffer;
- T4 was moved north-westwards to avoid deeper peat;
- T5 was moved south-eastwards to avoid deeper peat while maintaining elevation for wind resource;
- The hardstand of T7 was reorientated to move it out of deeper peat;
- T15 was moved off deeper peat, but this meant the separation ellipse between T14 and T15 was no longer acceptable, and as a result T14 was also moved, taking peat depths as well as ecological constraints into account.
- T16 was moved down the slope onto an area of shallower peat;
- T17 was moved out of deeper peat but was constrained by aviation, and hydrological features;
- T19 was moved to optimise wind resource; and
- The turbine numbering was rationalised and reordered.

3.7.23 Furthermore, the substation and Battery Energy Storage System (BESS) were adjusted to avoid areas of deeper peat. Two accesses were provided to the BESS for fire safety reasons.

3.7.24 Construction Compound 1 was moved to an area of shallower peat. An additional compound (SPEN Compound) was introduced for exclusive use by the Distribution Network Operator, SPEN, during their construction of the substation and completion of the grid connection. A third, smaller construction compound (Construction Compound 3) was included to be used by construction contractors.

3.7.25 In addition, three borrow pit search areas and their access tracks were identified to support construction material sourcing.

3.7.26 The Application Site boundary was expanded slightly in several areas.

3.7.27 This design was considered to be optimal from environmental, technical and economic perspectives and is the layout for which an application for Section 36 consent will be submitted.

3.7.28 The final design consists of 20 turbines within a Site which covers an area of 1088.54 ha. **Layout E: Final Design** is the Proposed Development on which the impact assessments in this EIA Report are based, and is shown on **Figure 1.2: Proposed Layout**.

Table 3.3: Summary of Key Stage Design Iterations

Design Iteration	Figure	Date	Key Parameters	Main Drivers for Change
A (Initial Layout)	N/A	January 2024	• 26 turbines • All Turbines 149.9 m • Initial red line boundary – 851.2 ha.	N/A – Initial Layout
B (Scoping Layout)	3.2	April 2024	• 26 turbines • All Turbines 149.9 m • Initial red line boundary - 851.2 ha.	Avoidance of peat deeper than 0.5 m where possible. All turbines located outside 50 m watercourse buffers. Angle of slope.
C (Additional Land)	3.3	September 2024	• 20 turbines (10 removed and 4 added from Iteration B) • All turbines 149.9 m • Extended red line boundary – 1,004.32 ha.	Aviation constraints, residential amenity concerns, partial location of ancillary infrastructure (e.g. turbine hardstands) within the 50 m watercourse avoidance buffer, ecological constraints and constructability requirements.
D (Design Chill)	3.4	November 2024	• 20 turbines • All turbines 149.9 m • Additional red line boundary extension – 1,011.82 ha.	Aviation, residential amenity (visual and noise), peat depths (based on Phase 1 peat data interpolation), mine entries, ecological and hydrological constraints.
E (Final Layout)	1.2	February 2025	• 20 turbines • All turbines 149.9 m • Further red line boundary extension – 1,088.54ha.	Phase 2 peat probing, reconnaissance walkovers conducted for hydrology, geohydrology, private water supply (PWS), and borrow pit search areas.

3.8 References

Scottish Government (2017). The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017. Available at: https://www.legislation.gov.uk/ssi/2017/101/contents

Scottish Government (2013). Planning Advice Note 1/2013: Environmental Impact Assessment. Available at: https://www.gov.scot/publications/planning-advice-note-1-2013-environmental-impact-assessment/

Scottish Government (2019). Climate Change (Emissions Reduction Targets) (Scotland) Act 2019. Available at: https://www.legislation.gov.uk/asp/2019/15/contents/enacted

Scottish Government (2022). Onshore Wind: Policy Statement 2022. Available at: https://www.gov.scot/publications/onshore-wind-policy-statement-2022/

NatureScot (2017). Siting and Designating Wind Farms in the Landscape. Guidance (Version 3a). Available at: https://www.nature.scot/doc/siting-and-designing-wind-farms-landscape-version-3a