3 Design Evolution and Alternatives

3.1 Introduction

This chapter provides a description of the site selection process and design strategies that were adopted in arriving at the final layout of the Proposed Development, as described in **Chapter 2: Proposed Development Description** of this Environmental Impact Assessment (EIA) Report. The final layout of the Proposed Development is shown in **Figure 1.3 Site Layout**.

It describes the site selection process, including the implications of the application made for a wind farm on this site which was refused by Scottish Ministers in 2019, outlines the key constraints, reviews the considered alternatives and details the design evolution adopted that allowed the Applicant to arrive at the final layout of the Proposed Development.

This chapter draws on issues considered in more detail in the relevant technical chapters (**Chapters 5 to 13**). 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 iteration of the layout design of the Proposed Development.

A detailed Design Statement has been prepared which is submitted as a separate document to support this Application.

3.2 Current Land Use and Site Context

The site is currently utilised as commercial forestry plantation and open rough grazing for livestock.

3.3 Site Selection Considerations

The Applicant maintains a sophisticated Geographic Information System (GIS) model for site selection which seeks to mirror planning, environmental, technical and commercial constraints. Although the site had previously been identified as an suitable site, the model was run again as the GIS model is updated regularly when new data becomes available or when factors change. Where available and appropriate, the GIS model incorporates published advice from statutory consultees.

The Applicant's use of the GIS model enables objective and consistent treatment of the whole country to assist with site selection.

The GIS model is based upon a combination of generalised and graded suitability layers covering environmental, economic and technical aspects, known as 'key layers'. All key layers are assessed using a 0% – 100% suitability scale, represented by a 0 – 1 score, where 0 represents unsuitable and 1 represents 100% suitability.

The key layers included in the GIS model are as follows:

- wind speed;
- proximity to housing;
- natural and built heritage constraints; and
- slope constraint.

In addition, for each site, a visual sweep of the following 'informative layers' is carried out:

- national and local planning policy / development plans / spatial frameworks;
- MOD tactical training areas;
- electromagnetic links and utilities;
- proximity to other wind farm sites (pre-planning, consented and operational); and
- other information gleaned from maps or knowledge of the area such as masts, undesignated parks, tourist attractions, etc).

These informative layers are included in the GIS model for information, but not scored and combined into the results.

The Applicant undertook an analysis of its GIS model and after having scored with medium to excellent preferability on all inputs, the combination of the scored layers results in a good score for the site.

3.4 Key Issues and Constraints

Having re run the GIS model and found that the site was still identified as suitable, key issues and constraints for consideration in the design process were established through a combination of desk-based research, extensive field survey and consultation (through the EIA scoping process). The design process considered the following key issues and constraints:

- Wind speed data;
- Landscape and visual considerations, including the findings of the previous application decision;
- Distance to private dwellings;
- Natural and built heritage constraints and Archaeology;
- Slope, peat and soil constraints;
- Nearby wind farms;
- Grid connection distances and costs;
- Site access;
- Ecology and ornithology;
- Local development plan policies;
- Electromagnetic links and utilities;
- Aviation and MOD tactical training areas; and
- Local knowledge and other information about surrounding undesignated parks and tourist attractions etc.

Information in respect of the survey work to identify various key issues and constraints and how they have contributed to the layout design has been investigated in greater detail in the technical chapters of this EIA Report (**Chapters 5 to 13**).

The key issues and constraints gleaned from the assessments within the technical chapters has been taken into account in the design mitigation process of the Proposed Development within the site. This allowed the Applicant to apply effective mitigation during the design process, and thereby avoid or minimise potentially significant effects as far as reasonably practicable. A summary of the potential effects addressed through the design process and the issues remaining following the selection of the final design is provided in **Table 3.1**

Table 3.1 – Summary of Mitigation by Design.

ISSUE	ENVIRONMENTAL CONSTRAINT / POTENTIAL EFFECT	MITIGATION BY DESIGN	ISSUES REMAINING
Landscape and Visual	Potential landscape and visual impacts were a key issue for the design iteration process. This is discussed in further detail subsequently in Section 4 of the Design Statement . Landscape and visual matters were considered during the design process. Key design viewpoints were developed and were also included subsequently as LVIA Viewpoints reflecting the key visual receptors raised in the Reporter's Report and Decision of the Scottish Government in relation to the 2016 scheme.	The design of the Proposed Development has taken account of: • Views from nearby residential properties; • Views from other settlements, roads and public rights of way; • Potential effects on Landscape Character; • Potential effects on Designated Landscapes; and • Additional and total cumulative effects.	The landscape and visual effects of the Proposed Development are addressed further in **Chapter 5: Landscape and Visual Impact Assessment**, and in the Design Statement which is submitted as a separate document to support this application.
Archaeology and Cultural Heritage	Effects on cultural heritage assets identified across the site.	The turbine layout has been designed to avoid heritage assets identified during the scoping assessment. The removal of the two northernmost turbines present on the scoping layout has extended the buffer between the nearest non-statutory register (NSR) asset and the Proposed Development from 145 m to over 400 m.	The archaeological and cultural heritage effects of the Proposed Development are addressed further in **Chapter 6: Cultural Heritage**.

ISSUE	ENVIRONMENTAL CONSTRAINT / POTENTIAL EFFECT	MITIGATION BY DESIGN	ISSUES REMAINING
Ecology	Effects on: • Annex 1 and priority habitats; • Peatland habitats; • Watercourse habitats and otters; and • Bat collision risk.	• Designed to avoid areas of these habitats • Access track layout has been designed to maximise the use of existing tracks. Floating tracks to be used where peat depth > 1m, where appropriate • New watercourse crossings have been avoided in the design of the access track layout as far as possible. • Minimum 50m buffer will be implemented between turbine blade tip and edge habitats.	The ecological effects of the Proposed Development are addressed further in **Chapter 7: Ecology**.
Ornithology	Collisions between turbines and Greenland White Fronted Geese.	The two northernmost turbines were removed from the scoping layout in response to geese flightlines mapped during vantage point ornithology surveys to reduce potential impacts on Greenland White Fronted Geese.	The ornithological effects of the Proposed Development are addressed further in **Chapter 8: Ornithology**.
Ornithology	Impacts on Golden Eagles	Turbines have been moved from open land to forestry.	The ornithological effects of the Proposed Development are addressed further in **Chapter 8: Ornithology**.

ISSUE	ENVIRONMENTAL CONSTRAINT / POTENTIAL EFFECT	MITIGATION BY DESIGN	ISSUES REMAINING
Hydrology Hydrogeology, Geology, Peat and Soils	Effects on any deep peat identified across the development site.	Turbine 3 of the scoping layout has been moved west from the open area overlying priority peatland into commercial forestry. A Phase 2 peat survey has been undertaken and has confirmed the presence of localised pockets of deep peat within the western area of the site and more extensive peat deposits with areas of deep peat within the eastern and south eastern areas of the site. The Phase 2 survey data has been used to support extensive design work to avoid areas of deep peat (>1.0m) and peatland in near natural condition. The following areas have been avoided: • Areas of deep peat, requiring potentially large volumes of excavation; • Areas of very wet peat (such as flushes, pool and hummock complexes and gullied peatland) which might be important for hydrological connectivity; • Areas of moderate to steep slopes (where site infrastructure might increase the chance of peat instability); and • Areas of sensitive habitat.	The effects of the Proposed Development on peat and soils are addressed further in Chapter 9: Geology, Hydrology and Hydrogeology.

ISSUE	ENVIRONMENTAL CONSTRAINT / POTENTIAL EFFECT	MITIGATION BY DESIGN	ISSUES REMAINING
Hydrology, Hydrogeology, Geology and Soils	Effects on watercourses across the site.	One turbine (T9 of the Design Chill Layout) has been removed as it is not possible to avoid deep peat whilst remaining out of the 50m buffer to watercourses.	The hydrology and hydrogeology effects of the Proposed Development are addressed further in **Chapter 9: Geology, Hydrology and Hydrogeology**. In addition, an outline Pollution Prevention Plan is available as part of the Outline Construction and Environmental Management Plan (CEMP) in Technical Appendix 2.1.
Traffic and Transport	The following sensitivities related to Traffic and Transport have been considered: • Severance; • Driver Delay; • Pedestrian Delay and Amenity; • Fear and Intimidation; • Road Safety; and • Dust and Dirt.	Construction Traffic Management Plan (CTMP) which identifies measures to potentially reduce number of construction vehicles, consider construction programming, routing and identification of an individual with responsibility for managing traffic and transport effect.	The traffic and transport effects of the Proposed Development are addressed further in **Chapter 10: Traffic and Transport**. The chapter concludes that effects of the increased traffic during the Proposed Development's construction phase are deemed to be Not Significant prior to the introduction of any mitigation measures. For good practice. a CTMP is to be prepared post-consent to further mitigate any effects of the Proposed Development.

ISSUE	ENVIRONMENTAL CONSTRAINT / POTENTIAL EFFECT	MITIGATION BY DESIGN	ISSUES REMAINING
Acoustic	Potential effects at nearby properties due to operational and construction noise with potential for cumulative impact.	The Proposed Development has been designed to reduce the potential for noise effects on nearby properties by following relevant national standards and design guidance.	The noise effects of the Proposed Development are addressed further in **Chapter 11: Acoustics**.
Shadow Flicker	Potential effects of shadow flicker on residential receptors.	The Proposed Development includes distancing of at least 1,650m from any turbine to the nearest inhabited dwelling. There is an allowance included for 100m micro-siting, and 1,650m allows for ten-rotor diameters (1,550 = 10 * 155) +100m as shown in **Figure 13.1 Shadow Flicker Assessment**); and thus no flicker is predicted.	Shadow flicker impact is addressed in **Chapter 13: Other Issues**.

3.5 Design Principles and Alternatives

The principles of the EIA process require that site selection and layout design be iterative and constraint-led, to ensure that potential 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*".

This section will review the principles of the layout design and alternatives options for the Proposed Development.

Design Principles

As part of the iterative approach adopted by the Applicant, a number of design principles have been incorporated into the Proposed Development as standard practice. This has been informed by constraint information obtained from the baseline survey and extensive field survey and consultation (through the EIA scoping process) which were collated and mapped to establish the potentially developable area for the siting of wind turbines within the site. From the outset, the Applicant also considered the findings of the previous application decision in relation to visual impact.

The land within the site covered by the following constraints was taken out of the developable area where turbines could be sited:

- Landscape designations and visual amenity and proximity of residential properties;
- Archaeological and cultural heritage assets;
- Sensitive fauna and habitats;
- Ornithology;
- Peat and soils;
- Watercourses, private water supplies and sensitive surface water features;
- Topography and ground conditions;
- Public road accessibility;
- Recreational and tourist routes;
- Acoustic;
- Shadow flicker;
- Aviation and defence constraints; and
- Presence of utilities.

Alternative Sites

The Applicant 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, the Applicant is continually assessing potential sites. The pipeline of potential sites is commercially sensitive and are not considered to be alternative sites to the Proposed Development. Alternative sites are therefore not considered further in the EIA Report.

Do Nothing

The "do nothing" scenario is a hypothetical alternative conventionally considered in the EIA Report as a basis for comparing the development proposal under consideration. This scenario is considered to represent the current baseline situation as described in the individual chapters of this EIA Report.

In the absence of the Proposed Development, it is anticipated that the site would continue to be managed as a combination of grazing livestock and commercial forestry. These land uses would continue on the site whether or not the Proposed Development proceeds.

Infrastructure & Technologies

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 electricity from wind turbines.

Advances in wind turbine technology mean that larger, more efficient wind turbines are now being deployed and it is recognised that wind turbines will continue to increase in tip height and rotor diameter in order to maximise the generation of electricity. To ensure optimal capture of wind energy and associated generation of electricity, spacing between wind turbines increases with wind turbine size usually leading to fewer, more productive wind turbines across any given site.

The final selection of the wind turbine tip height of up to 180m was considered to represent the best balance of tall wind turbines and design in the landscape. These considerations and the final selection of wind turbine height are described in Section 3.6 of this chapter.

Public Consultation

The Applicant has undertaken two rounds of public consultation in the form of public exhibition events held in the local area. The first event took place at scoping stage in November 2023, with the second event held in March 2024 following the Design Chill milestone. Both events were held at Tayinloan Village Hall, 2km west of the Proposed Development site. Photomontages were presented from a range of local viewpoints and attendees were invited to give verbal and written feedback on the day, or submit comments through the project website. Full details of the consultation events and feedback received can be found in the Pre-Application Consultation (PAC) Report which accompanies the application.

In relation to design, the majority of respondents (58%) were “neutral” towards the preliminary design of the Proposed Development, with a further 14% saying they were “happy” with it. The reduction of the number of turbines from 12 to 10 (subsequently reduced to 9 turbines at design freeze) was welcomed and viewed as a positive. Attendees were pleased that ornithological surveys had been undertaken and influenced the site design and positioning of turbines

3.6 Design Evolution

With consideration to the key issues and constraints, up-to-date wind turbine technology and the design principles set out above, the final layout of the Proposed Development was the result of several iterations as outlined below. The layout iterations are shown on **Figure 3.1 Site Layout Design Evolution** and **Figure 9 Combined On-site Constraints Map** in the Design Statement which accompanies the application shows how the key constraints discussed above informed the design.

The Scoping Layout (Layout A)

The ‘scoping layout’ for the Proposed Development was included in the Scoping Report as a useful focus for discussions with consultees and interested parties. This layout comprised 12 wind turbines of up to 180m to blade tip. This was based largely on future wind turbine availability, technical acceptability, and operational efficiencies. However, it was informed by preliminary landscape and visual analysis and high-level site constraints gathered from available desktop data sources.

Given there are no existing wind farms in close proximity, there was no requirement to consider potential energetic losses caused by neighbouring wind turbines. The Proposed Development would not therefore compromise the operation of any existing wind farms.

Ornithological surveys identified a golden eagle pair active in the territory around the site in 2022 and 2023. As coniferous woodland is of low habitat value to this species, it was decided to locate the majority of the turbines within the woodland area, with the exception of the easternmost turbine which was deemed to be a sufficient distance from the main eagle activity across the open moorland.

Design Stage - Layout B

Following scoping responses, the two northernmost turbines were removed from the layout due to geese flight lines mapped during vantage point ornithology surveys; to reduce potential impacts on Greenland white-fronted geese.

The removal of these turbines allowed for the previously easternmost turbine to be relocated into the coniferous woodland ensuring further mitigation for the golden eagles, with one turbine moving slightly outside of the woodland to the north-west.

Design Chill - Layout C

The loss of two turbines and 12MW of installed capacity led the Applicant to investigate the potential for a more powerful candidate turbine model. Once access studies had determined that a slightly longer blade length could be transported to the site, the candidate turbine was changed from a 6MW turbine to a 6.6MW turbine, resulting in a larger rotor diameter but no change to the overall tip height.

As a result, the Proposed Development's generating capacity increased from 60MW to 66MW, thus compensating for the loss of one of the two turbines. Due to the slightly larger rotor diameter, minor changes were made to some turbine locations

in order to achieve optimal wind exposure. This layout was then confirmed as "Design Chill".

Design Freeze, Final Turbine Layout - Layout D

Following the Design Chill, infrastructure including the site access tracks, substation and construction compounds were added to the layout and phase 2 peat and hydrology surveys were undertaken. The aim was to ensure that turbines and infrastructure avoided peat depths greater than 1m and retained a 50m clearance from hydrological features where possible.

Following the survey results, one further turbine was removed from the layout due to unavoidable deep peat and hydrology constraints, leaving the final layout of nine turbines with an overall generating capacity of 59.4MW.

Micrositing

In order to address any localised environmental sensitivities, unexpected ground conditions or technical issues that may be found during detailed post consent intrusive site investigations and construction, it is proposed that 100m micrositing allowance around the wind turbine locations and all other infrastructure is allowed. The technical assessments (presented in **Chapters 5 to 13**) have considered the potential for micrositing at this distance.

During construction, the need for any micrositing would be assessed and agreed with the on-site Environmental Clerk of Works (ECoW).

3.7 Summary

The Proposed Development was the result of extensive iterative design work, to sensitively locate the wind turbines and the infrastructure required to facilitate construction and operation of the wind turbines.

The design of the Proposed Development is the result of a considered design process that has evolved over the course of four proposed layouts, from an initial scoping layout comprising 12 turbines with a proposed blade tip height of up to 180 m, a layout consisting of 10 turbines with a blade tip height of up to 180 m and a further iteration which sought to further reduce the potential impacts arising from the scheme. The final 9 turbine proposed layout has been designed to respond to character and scale of the landscape, in addition to other environmental and technical constraints. The associated infrastructure has also been sited sympathetically so as to limit its influence on the surrounding landscape.