3. Design Evolution and Alternatives

3.1 Introduction

3.1.1 The design of the Proposed Development has been an iterative process, evolving from site selection and early feasibility studies to the final site design proposed. The evolution of the site design has taken into account various environmental and technical studies, alongside comments provided through consultation discussions.

3.1.2 The design evolution of the Proposed Development is discussed in the sub-sections below.

3.1.3 The Environmental Impact Assessment (EIA) Regulations states that an EIA Report should include:

- In paragraph 5(2)(d) of Part 1: *"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"*;
- Paragraph 2 of Schedule 4: *"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 project and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects."*

3.1.4 The consideration of alternatives studied by the developer is addressed in the sub-sections below.

3.2 Site Selection

Forestry and Land Scotland

3.2.1 In 2011, Forest Enterprise Scotland (FES) awarded the Applicant the exclusive rights to investigate the potential for new onshore wind energy projects within parts of the Scottish National Forest Estate in Argyll and Bute. In April 2019, Forestry and Land Scotland (FLS) became the sole Scottish Government Agency responsible for managing and promoting the National Forest Estate in Scotland, taking on the responsibilities of FES, as well as those of Forestry Commission Scotland.

Site Selection Process

3.2.2 The careful selection of potential wind farm sites is a critical aspect of the overall development process.

3.2.3 An initial assessment of the feasibility of the Scottish National Forest Estates sites was conducted using Geographical Information Systems (‘GIS’), to look at high-level constraints and key criteria for wind farm development. This process allowed early identification of key technical, environmental, planning and commercial issues, which could either support or potentially hinder the development of wind energy on individual sites.

3.2.4 Some locations were excluded, following this exercise, due to factors including lack of a suitable wind resource, ornithological sensitivities, landscape and visual sensitivities, planning policy, and commercial constraints.

3.2.5 At the conclusion of the initial assessment phase, the Development Site was identified as being potentially suitable for wind farm development as no significant constraints had been identified.

3.2.6 Potentially suitable sites identified during this first phase of the process were then subject to further feasibility assessments. Sites were evaluated, with those satisfying the basic assessment criteria progressing to the next stage of evaluation. These basic assessment criteria included (but were not limited to):

- **Land Availability**: ensuring there is sufficient land available for development;
- **Land Use and Context**: assessing the suitability of the existing land use and ensuring that the chosen site is out with international or national environmental or planning designations;
- **Wind Resource**: ensuring a sufficient wind resource exists to make the development financially viable;
- **Electricity Grid**: assessing whether the site is within appropriate proximity of a suitable connection point to the electricity grid network;
- **Transport Infrastructure**: ensuring the site is accessible via public road infrastructure to allow the construction, operation and maintenance of a wind farm;
- **Residential Amenity**: ensuring wind turbines can be located sufficiently far away from houses to protect local amenity with respect to noise and shadow flicker;
- **Landscape and Visual**: an initial assessment of the landscape and visual effects of a wind farm on important receptors (i.e. ensuring it is not located within a statutory designated landscape and taking into account considerations of landscape sensitivity and potentially sensitive visual receptors); and
- **Nature Conservation Sites**: an initial assessment to determine the distance of statutorily designated sites such as Sites of Special Scientific Interest (SSSIs), National Nature Reserves ('NNRs'), Ramsar Sites, Special Areas of Conservation ('SACs') and Special Protection Areas ('SPAs') from the site.

3.2.7 The conclusion of this feasibility assessment work was that the Development Site met the necessary basic assessment criteria and therefore warranted further detailed environmental and technical assessment.

3.2.8 The findings of the feasibility assessment study were subsequently built on by undertaking design and EIA work for the Proposed Development. This included undertaking consultations with relevant stakeholders such as NatureScot (formerly Scottish Natural Heritage ('SNH')), Royal Society for the Protection of Birds ('RSPB') and the Scottish Environment Protection Agency ('SEPA'), in order to understand their views on a potential wind farm at the Development Site and to ultimately assist in the evolution of an appropriate, responsibly designed wind farm.

3.2.9 Detailed assessment was undertaken to understand environmental and technical constraints. This process led to an initial 26 turbine layout, shown as 'Layout 1' on **Figure 3.1**, which took account of the criteria described above. This design has evolved as detailed in **Section 3.4**, to the Proposed Development of 22 turbines which is illustrated as 'Layout 4' on **Figure 3.1**.

3.3 Consideration of Alternatives

3.3.1 In EIA terms, the requirement of consideration of alternatives is to report on reasonable alternatives that have been considered by an applicant rather than it being a requirement of an EIA to identify and consider alternatives beyond those considered by an applicant.

3.3.2 Specific to the Proposed Development, alternatives in respect of layout, number of turbines and technology were considered and the alternatives in respect of these are set out below.

Without the Proposed Development

3.3.3 A description of the existing baseline conditions and the potential evolution of that baseline is described in each of the technical chapters. Without the Proposed Development, the status quo would be expected to remain, with the main land use of commercial forestry use continuing. From an environmental perspective, there would be a slight contribution towards climate change targets with small areas of the site identified for peatland restoration by FLS. Peatland restoration is also recognised as a primary objective within the East Loch Awe Land Management Plan, with the aim to "*identify future opportunities during post felling operational planning*."

Technology

3.3.4 The requirement for renewable energy is accepted at national policy level with wind energy widely recognised as the most mature renewable energy technology currently available. As identified during initial feasibility assessment, the Development Site was identified as having good wind resource conducive to the deployment of onshore wind turbine technology.

3.4 Design Evolution

3.4.1 The layout and individual siting of the turbines, battery storage and associated infrastructure has progressed through a number of design iterations and refinements, influenced by the EIA process. The design iterations are summarised in **Table 3.1** and illustrated within **Figure 3.1**. A 50m micro-siting allowance is proposed for the turbines (including the directly associated infrastructure) and the permanent Anemometer mast, and an increased100m micro-siting allowance for all other infrastructure to build in contingency for unforeseen ground conditions such as due to the existing forestry. Consent is sought for an operational life of 35 years.

3.4.2 The Applicant, and its consultants, undertook discussions with statutory and non-statutory consultees, the local community and the landowners with the accumulated findings all having an influence over the evolution of the design and the scope of the EIA.

3.4.3 The design of the Proposed Development has evolved in response to comments provided through various consultation discussions, desk studies and site work/technical appraisals by the project team. This process began following constraint mapping to create a developable area with the Development Site and the subsequent undertaking of initial tasks to inform investigations into the feasibility of developing a wind farm in this location.

3.4.4 A 26-turbine layout ('Layout 1') was developed, based on the wind yield, minimum separation distances between turbines and a desktop-based review of the identified constraints (**Figure 3.2**). This design formed the basis of the 2020 and 2022 EIA Scoping Reports. A detailed, iterative, process of design refinement has been undertaken

subsequently, which are illustrated as 'Layout 2', 'Layout 3', and resulting in the Proposed Development 22 turbine layout, shown as 'Layout 4' on **Figure 3.1**.

3.4.5 Following consultation with FLS, the red line boundary was altered in the final layout (Figure 4.1) to include an additional area of felling.

3.4.6 Overall, embedded mitigation measures have been incorporated into the design and construction of the Proposed Development, to avoid, prevent or minimise significant adverse environmental effects where possible. These embedded mitigation measures are captured and discussed in the relevant technical chapters and a summary of the proposed mitigation measures is presented in **Chapter 17: Summary of Mitigation**.

3.4.7 **Table 3.1** summarises the main design alterations and the main constraints that have influenced the design.

Table 3.1 Primary Design Iterations

Layout details	Design Rationale/Comments
Initial feasibility designs, pre-2020	Initial layouts were prepared based on initial technical and environmental reviews. These were informed by wind yield, minimum separation distances between turbines, and topography, and by a review of constraints (such as existing infrastructure, residential properties, watercourses, roads, public rights of way, etc) which were buffered as appropriate.
Scoping Layout (26 turbines 180m tip height), June 2020	26 wind turbines and associated infrastructure. This layout was produced as a result of the initial feasibility discussed above, informed by wind yield, minimum separation distances between turbines, and topography, and by a review of constraints (such as existing infrastructure, residential properties, watercourses, roads, public rights of way, etc).
Scoping Layout (26 turbines 230m tip height), June 2022 ('Layout 1')	Due to turbine technological advances, and in line with Scottish Government climate change targets, the scheme was redesigned to revise the maximum tip height up to 230m. Other than the turbine dimensions, the layout was as previously presented in the 2020 Scoping Report (i.e. 26 turbines).
Interim design(s)	During the period of June 2022 to November 2022, the site design evolved to take into account potential constraints identified through consultation and technical assessment work. Specifically, the design evolution has been carried out to: ● Further reduce the effects on certain landscape and visual locations (VP3, 4, 6, 8, 9 and 13); ● Further reduce the effects on cultural heritage receptors, focused on VPs relevant to the Dun na Cuaiche Watchtower (LB11543), Castle Lachlan (SM292) and a LVIA viewpoint at Kilmaha as proxy for lower-lying Scheduled Monuments on the north shore of Loch Awe; ● Optimise of the layout to account for constructability constraints such as slope angle; ● Avoid unacceptable impact of Turbine 8 on local radar; ● Take into account the Phase 2 peat probing survey results to reposition turbines in areas of shallower peat; and,

Layout details	Design Rationale/Comments
	• Avoid constraints such as ornithology receptors, telecommunications links, watercourses (and associated buffers), etc.
Public Consultation (25 turbines, 230m tip height), September 2022 ('Layout 2')	During the public consultation undertaken in 2022, a 25-turbine layout was displayed. Due to unacceptable impacts being identified upon the radar, as well as encroachment on diver nesting buffer zones, one turbine was removed from the layout (Turbine 8 in Scoping Layout).
Design Chill (22 turbines, 200m tip height), November 2022 ('Layout 3')	Several full EIA team design workshops have been held to optimise the layout, taking into account constraints identified, and reducing the layout to 22 turbines. The design evolution (including tip height reduction) has aimed to reduce landscape and visual effects (for example from VP3, 4, 6, 8, 9 and 13), cultural heritage (considering receptors described for the interim design above) and cumulative effects identified, with wireframes produced during the design workshops so that the layout options could be viewed 'live' as all constraints were considered. Site infrastructure has been designed as far as reasonably practicable to use the minimum land take. For instance, the access tracks have been designed to be linear, utilising existing forestry tracks and watercourse crossings, where practicable. The layout was refined to avoid habitats of highest ecological/ornithological importance and highest sensitivity to effects e.g. GWDTE's.
The Proposed Development (22 turbines, 200m tip height), Winter 2023 ('Layout 4')	Following the design workshop and further discussions, additional peat probing was undertaken in 2023 based upon the amended layout of 22 turbines (Layout 3). The site layout was then subsequently refined to take into account the updated peat survey data, with turbines and infrastructure located on shallow peat so far as practicable taking into account all other constraints on the site, whilst still retaining all 22 turbines. Detailed consideration of watercourses across the Development Site has been undertaken, with the site layout optimised as much as possible to take into account watercourse locations. The design was discussed with SEPA in a meeting held on the 27th October 2023. Information was provided to SEPA regarding distances the proposed site layout and watercourses on the Development Site and to demonstrate that the design has followed the peat mitigation hierarchy as detailed in NPF4 Policy 5 of avoidance and minimisation of impact. This is discussed further in **Chapter 12: Geology, Hydrology and Hydrogeology, Chapter 6: Renewable Energy, Carbon Balance and Peat** and **Table 3.2.** Following the design changes outlined above, this resulted in the final layout of the Proposed Development – 'Layout 4'.

3.4.8 **Table 3.2** summarises the primary design drivers that have influenced the design. Further details on the topic specific aspects that influenced the design are provided in technical chapters within this volume of the EIA Report.

Table 3.2 Key Design Drivers

Layout details	Design Rationale/Comments	
Watercourses	Hydrological constraints have fed into the site design process, this has included consideration of the locations of watercourses that cross the Development Site. An initial buffer of 50m was applied to watercourses (those displayed on 1:25k Ordnance Survey mapping), and site infrastructure designed to take these buffers into account. Where limited encroachment into the 50m watercourse buffer has occurred, this is discussed in greater detail below. Watercourse buffers in the vicinity of certain key locations can also be seen in **Figure 3.2**.	
	T2	Turbine foundation, primary crane hardstanding and auxiliary crane hardstanding encroachment into the 50m watercourse buffer. It is noted that the watercourse to the south is not visible on 1:50k OS mapping but is visible on the 1:25k mapping. The true course of the watercourses will be surveyed, and the final design adjusted e.g. ensuring that the auxiliary crane hardstanding's are either side of the watercourse. There is a commitment to the proposed micro-siting of turbine and infrastructure here and elsewhere such that watercourse buffer encroachment is minimised, although at this and other locations it cannot always be eliminated and reliance instead has to be placed on mitigation measures (see **Chapter 4: Description of the Proposed Development and Chapter 12: Geology, Hydrology and Hydrogeology).**
	T4	Auxiliary crane hardstanding encroachment into the 50m watercourse buffer. The crane hardstanding's have been previously rotated to avoid watercourse crossing and the turbine position moved south-west as much as possible within the confines of the watercourse buffers.
	T6	Turbine foundation, primary crane hardstanding and auxiliary crane hardstanding encroachment into the 50m watercourse buffer. Moving the turbine location to the north-east was ruled out as there is likely to be deeper peat in that area based upon the interpolated mapping.
	T9	Turbine foundation, primary and auxiliary crane hardstanding's and the blade laydown area encroach into the 50m watercourse buffer. It is noted that this is a minor watercourse which is not visible on 1:25k OS mapping. The true course of the watercourses will be surveyed, and the final design adjusted. T9 has previously been relocated ~35m south-west to avoid an area of deeper peat. Moving T9 to the south-east was discounted due to the gradient as this would increase the visibility of the turbine.
	T10	Previous design iterations had the turbine site infrastructure positioned within the 50m watercourse buffer. Subsequently,

Layout details	Design Rationale/Comments	
		T10 was relocated north-east to maintain the 50m watercourse buffer separation.
	T11	Previous design iterations had the primary and auxiliary crane hardstanding's within a 50m watercourse buffer (watercourse not visible on the 1:25k OS mapping). Subsequently, the turbine was relocated west to maintain this buffer.
	T13	Whilst the turbine foundation avoids the 50m watercourse buffer, the primary crane hardstanding, auxiliary crane hardstanding and blade laydown area do encroach on this buffer. This turbine is positioned next to a large crag. Reorientation of the crane hardstanding's would necessitate a large amount of cut. The auxiliary crane hardstanding's are located either side of the watercourse. The true course of the watercourse will be surveyed, and the final design adjusted accordingly e.g. ensuring that the auxiliary crane hardstanding's are either side of the watercourse.
	T17	Previous design iterations had the auxiliary crane hardstanding partially within a 50m watercourse buffer. The turbine was relocated slightly northeast to maintain this buffer.
	T19	The primary and auxiliary crane hardstanding's have been orientated to avoid a watercourse buffer.
	T20	The primary and auxiliary crane hardstanding's have been orientated to avoid a watercourse buffer. The turning head at this location does not encroach into the watercourse buffer.
Peat	Peat has been taken into account in the design process. Phase 1 and Phase 2 peat probing has fed into and influenced the final design of the Proposed Development, following the mitigation hierarchy as set out in Policy 5 of NPF4.	

Layout details	Design Rationale/Comments	
	T2	T2 has been located to avoid deeper areas of peat where possible. No probing was possible to the immediate south/south- east of the turbine due to windblown trees. These areas are extremely dangerous for a person to access due to hanging trees, broken branches, the need to climb over or under trees and the risk of falls. Tree removal is impractical at this time as tree removal would require a large area to be removed for machine access. The survey data points collected and shown in Appendix 6A are the closest possible locations to obtain data. The current data demonstrates that peat depths in this area of the Development Site are generally <1.0m and that there are opportunities to micro-site further within the allowance should the need arise.
	T3	T3 has been relocated to avoid deeper areas of peat where possible, this has included the reorientation of the crane hardstanding group. The auxiliary crane hardstanding is situated on the edge of an eroded area of peat. The peat data also indicates that peat shallows out to <1m within the space of <10m towards the south-west. This indicates it's a very narrow area of valley/basin peat. It is considered that there is sufficient data around the crane hardstanding group (particularly NE-SW) to model peat depths from which a reasonable assessment of the potential impacts can be drawn. In regard to the turning head, it is considered that there is sufficient data within and adjacent to the turning head as well as along the slope is it situated on to demonstrate that peat depths in this area of the site are <1.0m. The aerial imagery also indicates exposed bedrock in this area of the Development Site.
	T5	This turbine was relocated out of an area of deeper peat (Layout 4). Through the relocation of T5 a large reduction in peat impacts has been achieved, compared to the previous location which was to the south-west within the bog.
	T6	This turbine has been located in order to ensure that deeper areas of peat are avoided based upon the interpolated peat depth mapping. .
	T7	The turbine location was moved north-east and realigned to ensure that the primary crane hardstanding avoided an area of deeper peat. The access track has also been realigned to best avoid areas of deep peat. The crane hardstanding's are between probe points that are within 20m to the north and south-west. The south-western most hardstanding is also situated upslope of the slope break above which peat depths are <1m. It is considered that there is sufficient data around the hardstanding's to model peat depths from which a reasonable assessment of the potential impacts can be drawn.
	T8	This turbine has been located in order to ensure that deeper areas of peat are avoided based upon the interpolated peat depth mapping.

Layout details	Design Rationale/Comments	
	T9	This turbine location was moved approximately 35m south-west to avoid an area of deeper peat.
	T11	The location is considered to be optimal with regards to peat, bearing in mind the waterbody buffer and ornithological buffers nearby, including Golden Eagle, White-Tailed Eagle, Red Throated Diver and Osprey. In regard to the turning head, it is situated to the north-east of a peat escarpment. Therefore, the turning head is positioned off the peat bog and nearby probes indicate peat depths <1m locally.
	T12	During the development of Layout 4, T12 was relocated approximately 70m to the north-west. This was based on the findings of the first supplementary peat survey, as well as consultation with SEPA. The turbine has been relocated into an area of as low as possible peat depth alongside an existing forestry track. There is limited data in this location, however reconnaissance revealed that the turbine is situated at the edge of an existing borrow pit. In addition, areas of exposed deposits and/or bedrock are present along the southern edge of the access track. It also noted that the auxiliary hardstanding's are situated on the existing track.
	T14	A possible relocation north-west was considered, however it was determined that this location would increase the predicted excavated peat.
	T15	T15 has been relocated to the south-west to allow the edge of the crane hardstanding's to avoid an area of deeper peat. Probing is more limited on the hardstanding's; however, it is noted that probing has been completed within 10m of these features. In all locations except one, peat depths are recorded at <1m with most <0.5m. It is also noted peat depths locally further south and south-east are also generally <0.5 which indicates peat depths in this part of the Development Site are characteristically <0.5m. Therefore, it is considered there is sufficient data around the hardstanding's to model peat depths from which a reasonable assessment of the potential impacts can be drawn.
	T17	The turbine location was moved to the north-west to allow the crane hardstanding's to avoid areas of deeper peat.
	T18	The turbine location was moved to avoid areas of deeper peat and locate it on an area with peat depths <0.5m. Peat depths to the east of this location increase significantly up to >5m. Probing also informed the location of the areas of hardstanding, with peat depths below all locations except one, recorded at <1m.
	T20	Reorientation of the crane hardstanding group was considered at this location; however, this placed the auxiliary crane hardstanding's into a peat flush feature. Probing has been completed within 10-12m of the crane hardstanding's

Layout details	Design Rationale/Comments
	and turning head. In all locations peat depths are recorded at <0.5m. This indicates that peat depths in this part of the Development Site are characteristically <0.5m. It is considered that there is sufficient data near the hardstanding's to model peat depths from which a reasonable assessment of the potential impacts can be drawn.
Landscape and Visual	The design evolution has aimed to reduce landscape, visual and cumulative effects and to respect the landscape characteristics identified. During the design process, wireframes were produced to allow consideration of site layout changes upon the landscape and visual receptors. The design has embedded mitigation to reduce landscape and visual effects, such as locating turbines within coniferous forestry, as well as surrounding them by low-rising summits where possible.
Cultural Heritage	During the design process, data for both designated and non-designated heritage assets was made available to the design team to allow consideration for the avoidance of direct impacts upon heritage assets and to identify areas of higher sensitivity to change to setting.
Ecology	Site infrastructure has been designed as far as reasonably practicable to use the minimum land take. For instance, access tracks have been designed to be linear, where possible, to avoid creating islands of habitat fragmentation. The layout of the Proposed Development has also, wherever possible, avoided peatland habitat, and where avoidance has not been possible, has been designed to avoid habitats of highest ecological importance and highest sensitivity to effects. The Proposed Development has been designed to minimise watercourse crossings, and also has a buffer of 50m around watercourses and waterbodies (excluding watercourse crossings), where possible. As far as reasonably practicable, turbines were positioned at least 50m (measured from blade-tip) from any features.
Ornithology	Two turbines were removed (T8 - layout 1, and T24 - layout 2), to avoid diver nesting buffer zones and golden eagle corridors respectively. Four other turbines from layout 1 (T15, T22, T23, T26) were relocated to avoid sensitive areas and minimise impact on ornithology receptors, including golden eagles. The site layout has been designed as far as reasonably practicable to take into account the ornithological features identified. This has included a diver corridor buffer, which was taken into account in the iterative site design process.

3.5 Summary

3.5.1 As outlined above, a wide range of physical, environmental and technical issues have been addressed during the development of the wind farm design, and the Proposed Development is based on a thorough understanding and appreciation of local character and circumstances. The final design of the Proposed Development was the result of several stages of design iteration, informed by analysis of the environmental baseline, technical constraints, commercial considerations and comprehensive consultation.

3.5.2 As a direct consequence of the site selection and design processes outlined above, the Proposed Development contains embedded mitigation, including:

- Avoidance of internationally and nationally designated areas;
- Use of existing site access tracks and watercourse crossings, where possible;
- Reduction in turbine numbers from 26 to 22, and reduction in turbine height from 230m to 200m, thus materially reducing the scale and extent of landscape and visual impacts; and
- Avoidance of areas of deep peat.

3.5.3 The approach to mitigation is set out in **Chapter 2 EIA Approach**; the general project description is outlined **in Chapter 4 Description of the Proposed Development**. Where necessary, additional mitigation measures to address specific environmental effects are set out within technical **Chapters 6 to 16** and summarised in **Chapter 17 Summary of Mitigation.**

3.6 References

- Scottish Government (2023) National Planning Framework 4. Available at: https://www.gov.scot/binaries/content/documents/govscot/publications/strategy-plan/2023/02/national-planning-framework-4/documents/national-planning-framework-4-revised-draft/national-planning-framework-4-revised-draft/govscot%3Adocument/national-planning-framework-4.pdf (Accessed Jan 2024)
- Forestry and Land Scotland (2017) East Loch Awe Land Management Plan Summary. Available at: east-loch-awe-lmp-summary (forestry.gov.scot)
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