

# Environmental Impact Assessment Report

Beinneun 2 Wind Farm

Volume 1

Chapter 3: Site Selection and Design Evolution

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## 3 SITE SELECTION AND DESIGN

### 3.1 INTRODUCTON

This Chapter of the Environmental Impact Assessment (EIA) Report contains a description of the main alternatives considered, including the site selection process and the design evolution that led to the final design of Beinneun 2 Wind Farm (the Development) located approximately 5.4 km northwest of Invergarry and approximately 11.3 km southwest of Fort Augustus in the Highland Council area (the Site).

This Chapter of the EIA Report is supported by the following figures provided in Volume 2: Figures:

- Figure 3.1: Environmental Designations;
- Figure 3.2: Main Onsite Constraints; and
- Figure 3.3a-d: Site Design Evolution:
  - Figure 3.3a: Scoping Layout;
  - Figure 3.3b: Pre-Design Chill;
  - Figure 3.3c: Design Chill; and
  - Figure 3.3d: Final Design.

### 3.2 SITE DESCRIPTION

#### 3.2.1 Location and Characteristics

The Site is situated approximately 5.4 km northwest of Invergarry and approximately 11.3 km southwest of Fort Augustus. The Site comprises of active open moorland, centred on National Grid Reference (NGR) 223197, 805410. The Site covers an area of approximately 1,154 hectares (ha) with the location and extent shown on Figures 1.1 and 1.2. The Site lies wholly within the administrative boundary of The Highland Council (the Council).

The Site consists of open moorland, with no existing network of tracks. The surrounding area is characterised by further rolling hills featuring open moorland and upland heath, commercial forestry and woodland, and several water bodies. The topography of the Site varies; ranging from 260 metres (m) Above Ordnance Datum (AOD) to 490 m AOD in the west of the Site, to 370 m AOD to 660 m AOD in the east of the Site. The only named hilltop within the Site is Mullach Core Ardachaidh, at 530 AOD. There are a number of watercourses located within the Site, including Caochan Riabhach and Allt Dubh.

The nearby major roads include the A87 to the south and west of the Site, and the A887 located to the north of the Site. The Site will be accessed from the A87 in the west of the Site at approximately NGR 219586, 806801.

There are several settlements surrounding, the Site including (but not limited to):

- Invergarry, located approximately 5.4 km southeast of the Site;
- Fort Augustus, located approximately 11.3 km northwest of the Site; and
- Invermoriston, located approximately 18.2 km northeast of the Site.

There are six Core Paths within 5 km of the Site with the nearest of which being the River Garry Path, located 3.2 km southeast of the Site.

There are also seven listed Recreational Trails within 5 km of the Site, the nearest of which is Meall Dubh, from Glen Moriston, located approximately 750 m north of the Site.

Further details on nearby core paths and other recreational routes can be found in Chapter 13: Socio-Economics, Land Use, Recreation and Tourism.

#### 3.2.2 Land Use

The Site and immediate surroundings comprise open, moorland covered hills with relatively small areas of commercial forestry located on surrounding slopes where the hills drop down towards the surrounding valleys and lochs. Glen Garry lies to the south, Glen Morriston to the north, and Glen Loyne to the west.

The land is owned and managed by the Ardochy and Aberchalder Estates with estate activities including deer stalking.

As detailed in Section 3.2.1 above, there are no core paths, or any other formal routes or paths within the Site.

### 3.2.3 Designations

There are no legally protected areas (designations) within the Site as shown on Figure 3.1: Environmental Designations.

Where appropriate, Chapter 6: Ecology and Chapter 7: Ornithology of this EIA Report discuss the off-site ecological designations which are of relevance to the Development.

There are three Sites of Special Scientific Interest (SSSI) within 10 km of the Site. These include:

- West Inverness-shire Lochs, located approximately 208 metres west of the Site at its closest point;
- Garry Falls, located 3.0 km southeast from the Site; and
- South Laggan Fen, located 7.3 km southeast from the Site.

There is one Special Protection Area within 10 km of the Site, the West Inverness-shire Lochs located approximately 208 metres west of the Site at its closest point.

There is one National Nature Reserve within 10 km of the Site, Glen Affric, located approximately 9.7 km northwest of the Site.

There is one Special Area of Conservation within 10 km of the Site, the River Moriston, located approximately 2.1 km north of the Site.

There are three Geological Conservation Review Sites within 10 km of the Site. These include:

- Glen Doe, located 5.1 km north from the Site;
- Coire Dho, located 5.2 km north from the Site; and
- Fort Augustus, located 9.6 km east from the Site.

There are 15 Scheduled Monuments located within 10 km of the Site, the closest of which is the Fort Augustus-Bernera Military Road, 1890m W of Ceannacroc Lodge, located 3.5 km north of the Site.

There is one Battlefield Inventory Site within 10 km of the Site, Blar na Léine, located approximately 7.3 km southeast from the Site.

There are no Listed Buildings within 1 km of the Site.

The Site itself is not subject to any national landscape designations intended to protect landscape quality or scenery. Within 10 km of the Site, there is one National Scenic Area, two Local Landscape Areas, and three Wildland Areas.

The National Scenic Area is Glen Affric, located approximately 9.6 km northwest of the Site.

The Local Landscape areas consist of:

- Moidart, Morar and Glen Shiel, located 3.7 km west from the Site; and
- Loch Lochy and Loch Oich, located 5.5 km southeast from the Site.

The Wild Land Areas consist of:

- Central Highlands, located 4.3 km north from the Site;
- Kinlochhourn - Knoydart – Morar, located 9.1 km west from the Site; and
- Braeroy - Glenshirra - Creag Meagaidh, located 9.9 km southeast from the Site.

A full list and detailed description of the landscape designations within proximity to the Site can be found in Chapter 5: Landscape and Visual Impact Assessment.

### 3.3 SITE SELECTION

The selection of an appropriate site which has the potential to support a commercial wind farm development is a complex and lengthy process. It involves examining and balancing a number of environmental, technical, planning and economic issues. Only when it has been determined that a site is not subject to major known environmental, technical, planning or economic constraints is the decision made to invest further resources in developing the proposal and conducting an EIA. The main factors are:

- Suitable high annual mean wind speed across the Site;
- Viable potential grid connection;
- Suitable and proven port of delivery and road access for the delivery of large components;
- Suitable road access;
- Sufficient distance from the nearest residential properties to ensure compliance with appropriate noise limits, as well as to reduce adverse residential visual amenity and shadow flicker effects;
- Limited theoretical visibility of wind turbines from densely populated areas;
- Limited peat on site; and
- Not having any international or national ecological or landscape designations.

The Site meets the above criteria. There are existing wind farms on the same hill, to the north and north east: Beinneun Wind Farm, Beinneun Wind Farm Extension and Millennium Wind Farm. The principal landowner of the Site is one of the landowners of the existing Beinneun Wind Farm site, who identified the Site as meeting the above criteria and having seen the success (in all terms: commercial, environmental and social) of the other wind farms, Beinneun Wind Farm and its extension.

### 3.4 LAYOUT DESIGN

The purpose of a wind farm development is to harness the power in the wind to generate electricity. The optimum design is therefore to locate wind farms in areas exposed to the highest windspeeds, with turbines located in the optimum position. However, this does not take into account the potential environmental effects of a wind farm. The design of a wind farm must therefore be a balance between achieving an acceptable level of adverse environment effects and maximising energy yield. In addition to these factors, the technical limitations of constructing a wind farm must also be considered in the design stage.

The optimum layout of a wind farm is based on a range of technical criteria. A minimum distance must be maintained between wind turbines to reduce the effects of turbulence and associated increased turbine fatigue and reduction in energy yield. The following additional criteria must also be considered in the design of a wind farm:

- Wind speed;
- Prevailing wind direction;
- Existing infrastructure;
- Topography;
- Ground conditions;
- Local environmental issues and constraints; and
- Landscape and visual and cultural heritage considerations, relating to potential views of the wind farm.

The identification of environmental effects is an iterative process, running in tandem with the design process. As environmental effects and sensitivities are identified, the layout of the development undergoes a series of modifications to avoid or reduce potential environmental effects through careful design. This process has resulted in the layout of the Development presented in this EIA Report. This layout represents the optimum fit within the technical and environmental parameters of this Development.

In addition to the turbines, the other elements of the Development which have been designed to minimise environmental effects include: the access tracks, crane hardstanding areas, the temporary construction compound, borrow pits and the substation compound, and the Battery Energy Storage System (BESS). The effects of these have been minimised through use of existing track infrastructure where possible, careful design, siting, routing, and construction methods.

### 3.4.1 The Design Strategy

The approach to the design of the Development has considered, wherever possible, an approach and design that includes all of the following:

- Maximising the renewable energy generation capacity;
- Optimising the layout with respect to wind resource and environmental constraints;
- Optimising the layout with regard to topography;
- Limiting the number of turbines visible at key locations; and
- Limiting the overall visibility of the wind farm as much as possible.

Constraints were identified through desk study, site survey and analysis including consideration of the responses received from consultees during the early stages of the EIA process. The key constraints to onshore wind farm site design which need to be taken into account during the design process include:

- Visibility from sensitive receptors, including nearby properties, settlements and designated landscape. Wind farm layouts are designed to balance aesthetics from key viewpoints, taking account of landscape character types and the topography at and around the site, in accordance with the “Siting and Designing Wind Farms in the Landscape”<sup>1</sup> produced by Scottish Natural Heritage (now NatureScot);
- Presence of sensitive habitats and protected species;
- Presence of sensitive ornithological species;
- Presence of watercourses, private water supplies and related infrastructure;
- Presence of cultural heritage features and the perceived interaction between these e.g., sightlines;
- Proximity to noise sensitive receptors;
- Presence, extent and depth of peat; and
- Ground conditions and topography.

The principles of the design strategy were to maximise the number of turbines and wind energy capture, whilst minimising significant adverse environmental effects. Therefore, some of these constraints were given a ‘hard’ constraint value in design that was not breached and others were assigned a ‘soft’ constraint value that could be impinged with sufficient justification that effects were still acceptable. These constraints areas are shown in Figure 3.2. This led to a comprehensive process of constraints mapping. This EIA Report and its conclusions constitute the outcome of the application of the design principles adopted for the Development.

Embedded mitigation (layout decisions and use of control documents) was used to avoid, where possible, and then minimise any predicted environmental effects, and where applicable to a specific technical assessment, such mitigation is detailed in the relevant chapter within this EIA Report. Particular attention has been paid to measures set out in the Outline Construction Environmental Management Plan (oCEMP; TA A4.1), which has benefited from feedback from the construction phase of several other wind farm developments in Scotland, to minimise potential effects on the hydrological environment, soils and from noise and dust. By employing an iterative design process, undertaken in conjunction with the EIA process, a number of potential effects were avoided completely.

This approach is consistent with the mitigation hierarchy set out in the Scottish Government’s National Planning Framework 4<sup>2</sup>. In achieving this, there is a balance between the beneficial effects of a wind farm on climate change (as assessed in Chapter 10 of this EIA Report) and the potential adverse effects on other aspects of the environment. In optimising this balance, the aim was to maximise renewable energy generation whilst reducing adverse environmental effects to a level expected, based on case history across Scotland, to be acceptable in planning terms. Where adverse environmental effects could be reduced further than this, without affecting the renewable energy generation capacity, they were.

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<sup>1</sup> NatureScot (2017). Siting and designing wind farms in the landscape - version 3a. Available at: <https://www.nature.scot/doc/siting-and-designing-wind-farms-landscape-version-3a> [accessed on 13/04/2025].

<sup>2</sup> Scottish Government (2024). National Planning Framework 4. Available at: <https://www.gov.scot/publications/national-planning-framework-4/> [accessed on 13/04/2025].

### **3.4.2 Site Specific Environmental Constraints and Design**

#### **3.4.21 Landscape and Visual**

The turbine layout design sought to concentrate turbines within the central part of the Site and set them back from the southern and western edges of the site to reduce the proximity and mitigate visual impacts on receptor around Loch Garry and the A87 road. Unusually, for wind farms in Scotland, the result of this process was the identification of significant landscape and visual effects on only one receptor – a short section of the A87 road. Further detail on resulting landscape and visual effects is provided in Chapter 5: Landscape and Visual.

#### **3.4.22 Ecological Features**

Desk-based surveys and Site visits were undertaken as part of the ecology baseline studies which were used to inform the final design of the Development. Site surveys included the following:

- Habitat surveys (National Vegetation Classification and Groundwater Dependent Terrestrial Ecosystems); and
- Protected species surveys (fish, bats, otter, red squirrel, water vole, badger, pine marten and wildcat).

The purpose of these surveys was to identify sensitive habitats and species within and close to the Site to ensure that the Development's design would take them into account.

The results of the Phase 1 Habitat and NVC surveys highlight one element that is sensitive to the type of development proposed, and is widespread across the Site:

- Peatlands and related habitats.

The protected species survey data has been evaluated and identified the following species as being valued ecological receptors:

- Fish;
- Bats;
- Otter;
- Pine marten;
- Water vole;
- Reptiles/amphibians;
- Wildcat; and
- Badger.

Best practice, as detailed within Chapter 6: Ecology, has been adopted to avoid disturbance to protected species or direct effects on sensitive habitats; this largely relates to embedded mitigation including measures outlined in Chapter 16: Summary of Mitigation. The final layout was informed by the aforementioned surveys, which ensured that the Development avoided the most sensitive habitats.

Ecology effects are assessed within Chapter 6: Ecology.

#### **3.4.23 Ornithological Features**

Ornithological desk studies have been supplemented by field survey of the Site, including:

- Vantage Point (VP) flight activity surveys;
- Adapted Moorland Breeding Bird survey;
- Breeding Schedule 1 raptor survey;
- Black grouse survey; and
- Diver/scoter survey.

Ornithological features have been considered at all stages of the Development design, from initial feasibility to final layout. Standard best practice measures will also be implemented during construction.

Ornithology effects are assessed within Chapter 7: Ornithology.

**3.4.24 Archaeological and Cultural Heritage Features**

Minimising and avoiding changes to setting that may affect the cultural significance of designated heritage assets was an important driver in the design process.

Archaeological constraints were provided prior to design enabling direct physical construction impacts to be avoided through the design process. There are no designated or non-designated heritage features within the Site boundary.

Setting effects were considered through the design process. Alternative turbine layouts did not give rise to materially different effects on the setting of heritage assets, so no changes were required specifically in this respect. Effects on the settings of heritage features generally benefited from the changes made to the layout for landscape and visual reasons (see Section 3.4.2.1, above).

Further information about heritage assets is provided in Chapter 8: Archaeology and Cultural Heritage.

**3.4.25 Peat**

Peat depth surveys were undertaken across the Site, through which it was established that the majority of the Site was underlain with no peat or shallow (< 0.5 m) peat, however, numerous small pockets of deeper (1-3 m) peat occur across the Site. Areas of deeper peat were avoided where practicable, particularly where these were more extensive in area. Locations with shallower peat were used in preference, as far as practicable. Detailed Phase 2 peat probing was undertaken in specific locations where deep peat was identified, to allow design away from such areas as far as practicable.

Further information on peat is contained within Technical Appendix A12.2: Peat Landslide and Risk Assessment.

**3.4.26 Water Environment**

During the EIA process desktop and site surveys were carried out to inspect and identify all water features including public and private water supplies (where accessible) within the study area.

As detailed in Section 3.2.1 of this Chapter, there are a number of named watercourses within the Site, and several other unnamed channels which were viewed as watercourses and given appropriate buffers when drafting the detailed design.

The aim of the design process was to achieve a layout that avoids effects on sensitive hydrological receptors including public and private water supplies, initially by applying physical separation of infrastructure from watercourses in the layout, and then by applying good practice management and control measures to further limit the potential for effects.

The arrangement of access tracks has been designed to limit the number of watercourse crossings where possible. The Development layout will require 23 new watercourse crossings.

No private water supplies have been identified within 1 km of any proposed infrastructure. All proposed infrastructure is located outside of any Drinking Water Protection Areas (DWPAs).

Further information on the water environment is provided in Chapter 12: Hydrology, Hydrogeology and Soils.

**3.4.27 Noise Sensitive Receptors**

The potential for noise effects to arise at residential properties located in the surrounding area of the Site was an important consideration in the design process.

Background noise survey data collected at properties close to the Site was used to set noise limits, in accordance with guidance, against which predicted noise levels from the turbine layout could be assessed.

A noise assessment is presented in Chapter 9: Noise.

### 3.4.3 Site Specific Technical Constraints

#### 3.4.3.1 Wind Resource

Wind resource can be affected by various site characteristics, such as the prevailing wind direction, and local topography. As a rule, the more elevated areas of Site have the greatest wind resource and taller turbines increase access to the higher wind resource, and this must be balanced against the landscape and visual effects that may arise at higher elevations.

#### 3.4.3.2 Turbine Spacing

The spacing of the turbines is a key consideration in wind farm layout design; turbines need to be arranged a minimum distance apart such that turbulence from a specific turbine does not unduly affect the operation of a turbine which is downwind. The spacing is directly proportional to the size of the wind turbine rotor, whereby the larger the rotor the larger the spacing between turbines, and the fewer turbines that may be accommodated within a specific area.

The spacing chosen for the Development has been selected based on modelling assumptions and is designed to maximise the energy yield from the Development.

### 3.5 SITE ACCESS

The Site access will be afforded via an existing entrance point off the A87, at approximately NGR 219586, 806801 as shown in Figure 4.1.

Further details on access to the Site are provided in Chapter 11: Traffic and Transport.

### 3.6 DESIGN EVOLUTION

The final layout as presented in Chapter 4, Development Description, of the EIA Report has been the subject of a number of iterations and refinements which sought to avoid or minimise predicted adverse effects as far as reasonably practicable via design embedded mitigation. The resultant proposal balances the environmental and technical constraints, whilst producing an economically viable project. Design changes made as a consequence of the key constraints are considered to be mitigation which is 'embedded' within the design of the Development.

Whilst the Development went through numerous design iterations, the key turbine layout design iterations are described below and are shown in Figures 3.3a through to 3.3d which demonstrate how the layouts have evolved throughout the EIA process.

Each of the turbine layout iterations was devised based on the following technical parameters and constraints detailed below:

- Minimum turbine spacing/separation of approximately 5 times the rotor diameter in line with the prevailing wind direction (i.e., southwest) and 3 times the rotor diameter across the prevailing wind direction;
- 50 m buffers around the banks of watercourses for turbine locations, including the turbine foundation and hardstanding. To achieve this, a 70 m buffer of watercourses was applied in design (Figure 3.2);
- A hard constraint (not mappable) to reduce residential visual amenity to a level that would be acceptable, based on previous experience;
- An aim to minimise turbine locations in deep peat (> 0.5 m); and
- An aim to achieve a balanced visual composition that respects the original design objectives.

#### 3.6.1 Layout Design Iterations

Table 2.1 details the key design iterations that have taken place throughout, from Scoping through to the final design as described in Chapter 4. These design iterations can be seen in Figures 3.3a-3.3d.

**Table 2.1 Layout Design Iterations**

Layout	Number of Turbines	Design Notes
Scoping Layout	22 turbines of up to 200 m tip height	Initial feasibility based on preliminary environmental and technical considerations (desk-study only).
Pre-Design Chill	19 turbines of up to 200 m tip height	<p>The location of turbines was informed by a number of factors, including:</p> <ul style="list-style-type: none"> <li>• Avoiding oversail of the Site boundary;</li> <li>• Maintaining the required turbine spacing;</li> <li>• Avoiding land within 70 m of watercourses;</li> <li>• Avoiding areas uncovered by the Ornithological viewsheds;</li> <li>• Phase 1 peat surveys;</li> <li>• Maximising the number of turbines whilst optimising views of the turbines from key viewpoints, seeking to achieve a balanced design; and</li> <li>• The amending of the Site Boundary which led to amendments to the turbine layout and the removal of turbines.</li> </ul>
Design Chill	19 turbines of up to 200 m tip height	<p>The Design Chill layout incorporates infrastructure elements not present on the Pre-Design Chill Layout, including tracks, met mast, a substation and BESS compound, and potential borrow pit search areas.</p> <p>The turbine layout was also amended following a design meeting in which constraints and views of the turbines were considered, and the now available Phase 2 peat data was reviewed. This included the following:</p> <ul style="list-style-type: none"> <li>• T3 from the Pre-Design Chill layout was moved approximately 30 m northeast to avoid a deeper area of peat, and allow for a more efficient track layout; and</li> <li>• T20 from the Pre-Design Chill layout was moved approximately 115 m northeast to avoid an area of deeper peat. This was renumbered T19.</li> </ul> <p>The turbines were re-numbered, so that they ran from 1 to 19, and were ordered in sequence they would be experienced in, starting from the Site access point.</p>
Design Freeze	19 turbines of up to 200 m tip height	<p>The frozen design differs from the chilled design in that a construction compound was added in the west of the Site, several turbine locations were amended, and the Site Boundary was amended.</p> <p>T4 was moved approximately 48 m northwest due to an amendment to the Site boundary meaning the previous location would lead to oversail of the Site boundary.</p> <p>Refinements to the locations of turbines T6, T8, T9, T14, and T15 were made in order to avoid the 50 m watercourse buffer. This led to changes in the track design and crane hardstanding areas.</p> <p>The BESS and substation compound were also relocated approximately 30 m to avoid encroaching on a wet area of the Site. This move included additional track being added to allow a secondary access to the BESS compound for safety reasons (see Chapter 15: Other Issues).</p>

### 3.7 SUMMARY

Alternatives to the Development considered by the Applicant started by identifying a suitable Site, then designing a layout that minimised adverse environmental effects whilst maintaining the beneficial environmental effects. Various technical and environmental factors were considered in the iterative design process. These were informed through a variety of baseline surveys and consultation with a range of stakeholders.

The final turbine layout and associated infrastructure assessed in this EIA Report has been carefully developed taking these factors into account and is considered to balance the requirement to increase the renewable energy generation capacity of the Site whilst minimising the introduction of new environmental effects.

The final Development turbine layout and associated infrastructure is described in Chapter 4: Development Description and shown on Figure 4.1.