

2 Design Iteration

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2 Design Iteration

2.1 Executive Summary

- 2.1.1 This chapter describes the site identification and design iteration process which has been undertaken by the Applicant to determine both the location of the site and the design of the Proposed Development.
- 2.1.2 Throughout the process the Applicant has considered key environmental receptors and has aimed to remove and reduce environmental effects through design.

2.2 Introduction

- 2.2.1 The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017 state that the EIA Report must include *“A description of the reasonable alternatives (for example in terms of development 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”* (Schedule 4.2) (Scottish Government, 2017).
- 2.2.2 This chapter provides a description of the site selection process and design iterations that were undertaken prior to arriving at the final design of the Proposed Development, which is described in detail in Chapter 3 (Proposed Development).

2.3 Background and Needs Case considerations

- 2.3.1 The Proposed Development is one of three under development by the Applicant under Orkney’s Community Wind Farm Project. The aims of this project are threefold; to generate income to be used for the benefit of the people of Orkney, to aid towards a meaningful response to the Climate Emergency and the urgent need to further decarbonise, and to build the case for a new transmission connection for Orkney and unlocking wider benefits to the energy sector in Orkney.
- 2.3.2 In addressing these aims the scale of development is a critical issue. At present, Orkney is not served by a transmission grid connection and the distribution network is at capacity such that there has been a moratorium on new grid connections since 2012 and many operational wind energy projects are experiencing substantial constraint through an Active Network Management system. The lack of grid capacity has driven some innovation locally but the overall impact has been to heavily impede development of the energy industry.
- 2.3.3 In September 2019 the electricity market regulator Ofgem published its final decision on the needs case for a transmission connection linking Orkney to the Scottish Mainland. It determined that there is a need for a cable. To justify the required spending on a new cable, there is a requirement for Scottish Hydro Electric Transmission (SHE-T) to demonstrate that there will be sufficient generation capacity to connect to the new cable, once operational. Ofgem agreed that in order to trigger a new 220MW connection, 135MW of new generation is required to have obtained planning permission, signed up to a grid connection agreement, and passed a financial audit before the end of 2021. Currently less than 40MW of new wind has gained planning permission. Noting that there are a number of other private projects at different stages of development, it is clear that, without the Proposed Development and the other two wind farms within Orkney Community Wind Farm Project, the threshold will not be met and a new interconnector will not be built.
- 2.3.4 Furthermore, there is need to increase the proportion of energy generated through renewable sources in order to meet the Orkney Sustainable Energy Strategy 2017 – 2025 which strives for ‘a secure, sustainable, low carbon economy’. The provision of a minimum power generation in order to trigger the new 220MW connection will allow for greater flexibility to further develop renewable energy technologies within Orkney, including the world leading marine energy sector.

2.3.5 Developing all available sites with a realistic chance of contributing towards the Needs Case for a new cable to their realistic maximum capacity is viewed as the best way of ensuring that the aims outlined above are achieved.

Orkney Islands Council as a Developer of Onshore Wind Farms in Orkney

2.3.6 Orkney Islands Council (OIC) has therefore taken a number of decisions leading to the decision to become a developer of onshore wind farms in Orkney:

- As early as September 2013 OIC endorsed the principle of OIC establishing, developing or investing in an onshore wind farm project.
- At OIC Policy and Resources committee meeting of 21 June 2016 OIC approved the principle of OIC assuming the role of a project developer of onshore wind farm projects in Orkney.
- At general meeting of the OIC 4th July 2017 OIC resolved that a process should be undertaken to identify property owners in Orkney with large sites able to accommodate scale wind generation who would wish to sell or lease land for the purpose of a wind development.
- At OIC Policy and Resources committee meeting of 28th November 2017 it was recommended that OIC proceed to planning consent stage with development of a project on Hoy, at a maximum scale of approximately 108MW.
- At general meeting of the OIC of 5th March 2019 it was agreed that OIC should focus on developing all projects which have a realistic chance of achieving planning permission by the end of 2020 and therefore contributing to the Needs Case for a new grid connection to Orkney, namely Hoy, Faray, and Quanterness.

2.3.7 In terms of delivering community benefit to the people of Orkney there are currently substantial challenges around funding service provision in the area which Orkney's Community Wind Farm Project may be able to address provided income from the Project is of the scale required.

2.3.8 In order to maximise the local benefit from the proposed 220MW cable, it is also considered desirable to ensure that as much of the generation as possible is taken into local or public ownership, thereby ensuring that profits stay within Orkney.

2.4 Site Selection

Broad Site Identification and Selection

2.4.1 In response to the OIC decision to seek landowners with an interest in selling or renting land for wind farm development an Expressions of Interest (EoI) process was undertaken in August and September 2017 requesting landowners to get in touch with OIC. A number of responses were received, and each was assessed against defined criteria and compared against other sites received, and sites within OIC ownership.

2.4.2 The outcome of this process was the decision to focus on development of a project of up to 108 MW on Hoy.

2.4.3 Initial bird survey work in 2018 identified that a project of this scale was unachievable and that a project of around 30 MW was more realistic. The reduction in scale would limit the ability of OIC to contribute towards the Needs Case for a new cable and limit the potential level of income from the project.

2.4.4 A process was therefore undertaken in late 2018 to assess the whole of Orkney for potential for onshore wind farm development. This was done by buffering address point data and plotting international designated sites on a map and identifying those areas which were of sufficient size to host a wind farm and were not constrained by either of those limitations. Each site was then investigated in further detail to identify any additional potential constraints. A short list of sites was drawn up and used to inform a report to OIC.

2.4.5 Based on this work and followed up by a more targeted desk top study, the Island of Faray was purchased by the Council in January 2019 with a view to developing a wind farm on that site.

Quanterness Specific Site Identification

2.4.6 In 2017 as part of feasibility work for a private wire network project looking to link together OIC owned buildings in Kirkwall with a direct supply renewable electricity, thereby reducing costs and carbon production, work was undertaken to identify potential locations for the required generation. OIC therefore sought to identify potentially suitable sites for wind energy generation within viable distance from Kirkwall. The search began with OIC owned sites but did not identify any which were considered suitable based on an initial review of technical and environmental constraints.

2.4.7 A search was undertaken of land within 10 km of Kirkwall and sites were tested against an initial range of technical and environmental parameters. This review included consideration of:

- Scottish Planning Policy (SPP) (Scottish Government, 2014);
- Orkney Islands Council's adopted planning policies and relevant supplementary guidance;
- international, national and local designated sites;
- transport facilities;
- operating airports;
- residential receptors; and
- other operational and consented but not built, wind farm developments or proposed wind farm developments where a planning application has been submitted but not determined.

2.4.8 The land at Quanterness (refer to Figure 1.1) was identified as a potentially suitable development site, and further work was undertaken to establish feasibility of development and the potential scale and capacity of potential wind energy generation at the site.

2.4.9 The Quanterness site was therefore considered alongside responses from the 2017 EoI process (refer to paragraph 2.4.1) and subsequent wider work in 2018 to identify suitable sites for development.

2.4.10 In conjunction with the OIC decision on 5th March 2019 where it was agreed that OIC should focus on developing all projects which have a realistic chance of achieving planning permission by the end of 2020 and therefore contributing to the Needs Case for a new grid connection to Orkney, Quanterness was selected for progression towards an application for planning permission, alongside sites at Hoy and Faray.

2.4.11 Subsequent to this decision numerous surveys were undertaken on site which have contributed to the various design iterations presented below cumulating in the design detailed in Chapter 3 (Proposed Development).

2.5 Opportunities and Constraints

Opportunities

2.5.1 The Proposed Development site benefits from a number of opportunities as a wind farm site, including:

- status within planning policy;
- good wind resource and flat topography;
- lack of environmental designations;
- lack of watercourses, private water supplies or peat;
- contained landscape and visual effects;

- limited protected species or habitats within the site boundary;
- connectivity to connection points;
- connectivity to transport infrastructure; and
- current land use.

Planning Policy

- 2.5.2 The western half of the Proposed Development site falls within an area identified in the Local Development Plan Supplementary Guidance: Energy as “Areas with Potential for Wind Farm Development” (Orkney Islands Council, 2017b). The eastern half of the site falls within “Areas of Significant Protection” due to its proximity to the town of Kirkwall. The supplementary Guidance states that wind farm development may be appropriate in some circumstances at these locations subject to the applicant demonstrating that any significant effects on the qualities of these areas can be overcome to the satisfaction of the planning authority by siting, design or other mitigation.

Wind Resource and Topography

- 2.5.3 The Orkney Islands are one of the windiest places in the United Kingdom with an average wind speed of 7.36 m/s (Met Office, 2019). The turbine located at Rennibister has onsite average wind speeds of 8.6 m/s (Rennibister Wind Power, 2019).
- 2.5.4 The site is flat, raising gradually from 0 mAOD in the north to 20 mAOD adjacent to the A965. To the west, north and east the topography is similarly flat and low lying with the only feature in the landscape to the south being Wideford Hill with a summit 225 mAOD.

Ecological, Ornithological, Landscape, Cultural Heritage and Geological Designations

- 2.5.5 There are no ecological, ornithological, landscape, cultural heritage or geological designations within the site boundary. The closest designations within 5 km to the site are shown on Figure 2.1 and listed below:
- Heart of Neolithic Orkney World Heritage Site Sensitive Area lies to the south-west corner of the site (adjacent to the south-west corner of the site);
 - North Orkney Proposed SPA (directly adjacent to the northern boundary of the site);
 - Orkney Mainland Moors Special Protection Area (SPA) and Keelylang Hill and Swaraback Burn SSSI (1.8 km to the south-west);
 - West Mainland moorlands Site of Special Scientific Interest (4.6 km to the south-west);
 - Scapa Flow Proposed SPA and Orkney Inshore Waters Proposed SPA lies approximately 5 km south-east of the site;
 - Hobbister RSPB Reserve (2.9 km to the south) and Cottascarth & Rendall Moss RSPB Reserve (3.3 km to the north);
 - Three Local Nature Conservation Sites (LNCS) designated for ornithology are located within 5 km of the site: Wideford Hill (adjacent to the south-west corner of the site); Rennibister and North Mainland Coast: Evie to Finstown (adjacent to the northern boundary of the site); and Bridgend (980 m south-west of the site boundary);
 - 18 Scheduled Monuments, the closest being Quanterness Chambered Cairn and Prehistoric House (305 m to the south);
 - Kirkwall Conservation Area (3.2 km to the south-east);
 - Balfour Castle Garden and Designed Landscape (GDL) (4.5 km to the north-east); and

- 257 Listed Buildings (the majority located within Kirkwall), the closest being 2.4 km to the south-east (B Listed Grainbank House).

Peat, Private Water Supplies and Watercourses

- 2.5.6 There is no peat, private water supplies or watercourses within or adjacent to the site boundary. There are a number of small drainage ditches installed by the landowner that follow the field boundaries within the site.

Ecology and Ornithology

- 2.5.7 The site is mainly used by wading bird species with infrequent visits by protected raptors. The majority of the species identified using the site are classed as being of Local importance or lower, with one species of Council importance identified using the site to breed, curlew (*Numenius arquata*). Species of International importance were identified using the sea and coastline adjacent to the site but none of these species were identified as using the site to breed or forage.
- 2.5.8 The only protected non-avian species using the site are otters (*Lutra lutra*) and brown hare (*Lepus europaeus*). No resting places were identified within the site boundary but the surveys identified evidence of these species using the site as a commuting route.
- 2.5.9 The majority of the site not under crops is improved grassland with the dominant species being perennial rye-grass and meadow-grass.

Connectivity

- 2.5.10 The Proposed Development site has good transport links with direct access to a trunk road and a short transport distance to the port at Hatston. In addition the site is located close to two commercial quarries from which aggregate can be procured, minimising transport requirements.
- 2.5.11 The Proposed Development site is located in close proximity to the proposed substation at Finstown, and to Kirkwall. Therefore the connection distance to the grid or a private wire to Kirkwall (for provision to buildings or for hydrogen manufacturing) will be minimal (it should be noted that connection of the Proposed Development is not part of this application and therefore outwith the scope of the assessment of the EIA).

Land Use

- 2.5.12 The site is currently used for agriculture, both grazing of cattle and crop rotation. The loss of land to the Proposed Development would not impact upon the agricultural requirements of the landowner.

Landscape Sensitivity

- 2.5.13 There would be limited to no visibility of the Proposed Development from Hoy Wild Land Area (approximately 19 km to the south-west).
- 2.5.14 There is an existing influence on landscape character from operational wind farms located on the Mainland of Orkney. Operational Hammars Hill and Burgar Hill Wind Farms are the two main commercial wind farms visible from this local area, albeit located to the north-west, in the moorland hills of West Mainland at a minimum distance of 8.9 km and 12.8 km from the closest proposed turbine, respectively. The single turbines at Rennibister and Hatston Industrial Estate are located within closer range at 1.3 km and 1.6 km.

Constraints

Cultural Heritage

- 2.5.15 A number of non-designated sites are located within the site boundary, including three which are considered to have potential to be of regional/national importance (refer to Chapter 10 for further details).

2.5.16 The surrounding landscape includes a number of Scheduled Monuments and Listed Buildings whose setting could be impacted by the Proposed Development (refer to Chapter 10 for further details).

Landscape

2.5.17 Given the low-lying, relatively flat nature of the site and the surrounding area there is potential for the Proposed Development to be viewed from a number of different landscape and coastal character areas.

Noise, Shadow Flicker and Residential Visual Amenity

2.5.18 There are a number of residential properties within 1 km of the site: 1 and 2 Quanterness Farm Cottages (132 m from the site); Quanterness Farm (367 m from the site); Harwood (427 m from the site); and Saverock (662 m from the site). The design of the Proposed Development has had to take the impacts of the Proposed Development upon the residents of these properties, and others, into careful consideration during the design process.

Traffic and Transport

2.5.19 The A965 runs along the southern boundary of the site. This is the principal route from Kirkwall to the West Mainland and therefore closure or damage to the road would be a significant impact to local residents.

Topography

2.5.20 As mentioned in paragraph 2.4.4 the site is principally flat, raising from 0 mAOD to 20 mAOD. Although this is beneficially from a wind yield perspective, the low lying areas are at risk from sea flooding. SEPA has recommended that all infrastructure is placed above 3.5 mAOD.

Telecommunications

2.5.21 Through the EIA Scoping process the potential for an impact on a Joint Radio Company (JRC) telecommunication link was identified.

2.6 Design Principles

2.6.1 Taking into consideration the above constraints and opportunities, the following principles were adopted during the design iterations undertaken by the Applicant to ensure that the final design of the Proposed Development was the most suitable for the site:

- maximising wind yield and maintaining adequate spacing between turbines;
- avoid placing turbines below 5 m AOD;
- ensuring a minimum distance of 165 m between the turbines and A965;
- ensuring an appropriate separation distances between non-designated assets of regional importance and the Proposed Development infrastructure;
- consideration of key views, in particular from Cuween and Wideford Hill cairns;
- ensuring that the Proposed Development is compatible with other planned and consented wind farms on Orkney; and
- avoiding inconsistent turbine spacing, such as relatively large gaps, outliers or excessive overlapping turbines to minimise visual confusion and ensure a balance / compact array from key views.

2.7 Proposed Development Design Iterations

2.7.1 Following the selection of the site location (refer to Section 2.2 above) the Applicant has undertaken multiple design iterations of all aspects of the Proposed Development including the turbine layout

and the infrastructure layout. This Section describes the principal design iterations that have been undertaken as the Applicant has sought to maximise the number of turbines on the site, whilst minimising the environmental effects of the constraints identified above.

Turbine Layout

- 2.7.2 Throughout the design process and the different iterations, the Applicant has always considered a maximum turbine height of 149.9 m in order to optimise yield and power generation when balanced against likely environmental effects.

Layout A (EIA Scoping)

- 2.7.3 The initial site layout which was submitted with the EIA Scoping Report (refer to Appendix 4.1) aimed to maximise the number of turbines while ensuring the maximum distance between the turbines on the A965 and the residential properties at Quanterness. This layout placed the majority of the turbines along the northern boundary of the site, with the exception of T6 which was placed on the western boundary (refer to Figure 2.2). A spacing of 1.5 times the indicative rotor diameter was used to separate the turbines (204 m).

Layout B

- 2.7.4 Following receipt of the EIA Scoping Opinion (refer to Appendix 4.2) the Applicant undertook environmental surveys and started to consider turbine options for the Proposed Development. Based on currently available turbines it was determined that the blade of T6 in Layout A could oversail the site boundary into the neighbouring land. T6 was therefore moved to the east in Layout B to avoid oversailing (refer to Figure 2.2).

Layout C

- 2.7.5 As part of the EIA Scoping Opinion JRC raised a concern about potential impacts of T5 on their communication links. The Applicant undertook detailed consultation with JRC who recommended that T5 was moved 60 m to the north-east to avoid the telecommunication link (Layout C) (refer to Figure 2.3).

Layout D

- 2.7.6 The spacing between the turbines was increased from 1.5 times the indicative rotor diameter to two times the rotor diameter to improve wind efficiency between turbines (272 m).
- 2.7.7 As part of their EIA Scoping Response SEPA requested that all turbines are placed above 3.5 mAOD. In order to identify this the 5 mAOD contour mapping was highlighted and as a consequence T1 and T3 were moved south-east and south-west respectively (refer to Figure 2.3).
- 2.7.8 In order to ensure that the movement south of turbines did not encroach on residential properties at Quanterness Farm Cottages, Quanterness Farm and Harwood, a minimum separation distance of 600 m between the turbines and the properties was implemented to ensure that noise, shadow flicker and residential visual amenity would be acceptable (refer to Figure 2.3).
- 2.7.9 In addition the Applicant decided to increase the separation distance between the turbines and the site boundary to 118 m to allow for micro-siting, which moved T1 south-east.
- 2.7.10 To reduce the number of turbines visible from Wideford Hill Cairn and to accommodate the movement south of T1 and T3 T2 of Layout D was moved south of T6 of Layout C, while T6 of Layout C was moved to the south-east corner of the site (refer to Figure 2.3). This permitted T4 to move south-west slightly and increased the separation between the turbines on western half of the site and improved views from the west and south.

Layout E

- 2.7.11 Following consultation with the Applicant's archaeologists it was determined that T2 of Layout D was too close to Wideford Hill Cairn and moving the turbine east would decrease the visual extend of the Proposed Development visible from the cairn. T2 was therefore moved 270 m north-east,

towards the centre of the site (refer to Figure 2.4 and Figure 2.8). This had the additional benefit of increasing the separation distance between the turbines and Rennibister and the other residential properties to the west of the Proposed Development site.

- 2.7.12 The movement of T2 north-east had the knock-on effect of moving T3 and T4 to ensure the separation between turbines is maintained and avoid visual “bunching”. It was determined that T6 could be moved to the west to maximise separation distance between the turbines and Kirkwall. This would also increase the spacing between T5 and T6 and ensure no overlap of the spacing circles between the turbines.
- 2.7.13 The movement of the turbines was also considered relative to noise, residential visual amenity and shadow flicker effects at nearby residential properties.

Layout F (Application)

- 2.7.14 Layout E was re-submitted to JRC to determine whether the revised layout is acceptable. JRC raised concerns about the proximity of T5 to the telecommunication link and recommended moving T5 north-east by approximately 8 m. Following this movement Layout F became the layout which the application is based.

Infrastructure Layout

- 2.7.15 Following confirmation of the turbine locations the design of the accompanying infrastructure was considered. This included hardstandings, substation compound, temporary construction compound and access tracks.

Layout 1

- 2.7.16 Layout 1 (refer to Figure 2.5) was the initial layout. This had three main access tracks, one linking T1 and T2 to the west, a branch to T6 to the east, and a main access track linking the A965 to T3, T4 and T5. The construction compound was located adjacent to the access track branch to T2, with the substation compound located to the west of the construction compound.

Layout 2

- 2.7.17 Layout 2 improved upon Layout 1 by using the existing farm tracks where possible, and decreasing the length of new access track. Therefore the link between T1 and T2 was removed and a new branch to T1 provided along an existing west-east farm track.
- 2.7.18 In addition Layout 2 re-designed the principal access track connecting the site to the A965. In Layout 1 the new access track separated from the existing farm track at the first field boundary, however Layout 2 amended this to continue the usage of the existing farm track as far north as possible, leaving the existing farm track closer to T3. The hardstanding of T3 was then rotated to accommodate this alteration.
- 2.7.19 It was determined that a larger temporary construction compound would be required so it was relocated to the access track spur to T2, while the substation was re-located adjacent to the principal access track into the site to maximise its distance from turbines.

Layout 3

- 2.7.20 Layout 2 was taken to the landowner for discussion to ensure that it would not impact on the farm operations. The landowner proposed that the temporary construction compound be relocated north of the substation as the new location is a gentler gradient and would increase the distance between the construction compound and the residential properties at Quanterness Farm Cottages.
- 2.7.21 Following discussions with turbine manufactures it was also identified that the area of permanent hardstanding for each turbine could be reduced. Temporary laydown areas and turning circles will be required at each turbine, however these will be re-instated post-construction.

Layout 4

- 2.7.22 Layout 4 made a slight amendment to the orientation of the hardstanding and access track at T5 following T5's movement from Layout E to Layout F.
- 2.7.23 Layout 4 also identified an appropriate location for the met mast, and which sections of the access track would involve upgrades of existing track.

Conclusion

- 2.7.24 Turbine Layout F and infrastructure Layout 4 is the layout that has been taken forward as the design for the Proposed Development within this EIA Report. Further design work may be required following the detailed ground investigations which will take place post-consent. In this regard, there will be a micro-siting allowance of up to 50 m in all directions in respect of each turbine and its associated infrastructure in order to address any potential difficulties which may arise in the event that preconstruction surveys identify unsuitable ground conditions or environmental constraints that could be avoided. No micro-siting will be undertaken that results in an increase in the significance of adverse effects. The exception to this is turbine T5 which will not be micro-sited between 141° and 341° to prevent any impacts on the telecommunication links.

2.8 Do-Nothing Scenario

- 2.8.1 Should the Proposed Development as described in Chapter 3 (Proposed Development) not be consented (the “do-nothing scenario”), it is anticipated that the Proposed Development site will not alter from the current baseline described above and in Chapters 6-16.

2.9 Summary

- 2.9.1 The final layout has been informed by a robust environmental assessment and design iteration process, taking into account potential environmental, landscape and visual impacts and their effects, physical constraints, and health and safety considerations. The information used to inform the design iteration process included consultation responses received, baseline data and the impact assessment undertaken.
- 2.9.2 The final layout comprises six turbines of up to 149.9 m tip height, and their associated infrastructure, including hardstanding, access tracks, substation and met mast, as shown in Figure 1.2.
- 2.9.3 The Proposed Development layout is considered to represent the most appropriate design, taking into account potential environmental impacts on their effects, physical constraints, and health and safety considerations, while maximising the generating capability of the site.

2.10 References

- Met Officer (2019). *Windiest Parts of the UK*. Available at: <https://www.metoffice.gov.uk/weather/learn-about/weather/types-of-weather/wind/windiest-place-in-uk>
- Orkney Islands Council (2017a). *Local Development Plan*. Available at: <https://www.orkney.gov.uk/Service-Directory/O/Orkney-Local-Development-Plan.htm>
- Orkney Islands Council (2017b). *Local Development Plan – Supplementary Guidance: Energy*. Available at: https://www.orkney.gov.uk/Files/Planning/Development-and-Marine-Planning/Adopted_PPA_and_SG/Guidance_for_the_Plan/Energy_Supplementary_Guidance.pdf
- Rennibister Wind Power (2019). *Home*. Available at: <http://rennibisterwindpower.co.uk/>
- Scottish Government (2014). *Scottish Planning Policy*. Available at: <https://www.gov.scot/binaries/content/documents/govscot/publications/advice-and->

[guidance/2014/06/scottish-planning-policy/documents/00453827-pdf/00453827-pdf/govscot%3Adocument/00453827.pdf](https://www.gov.scot/document/00453827.pdf)