# 2 Design Iteration

## Contents


| | | |
|---|---|---|
| 2.1 | Introduction | 2-1 |
| 2.2 | Background | 2-1 |
| 2.3 | Site Selection | 2-1 |
| 2.4 | Alternative Sites | 2-1 |
| 2.5 | Design Process | 2-2 |
| 2.6 | Summary | 2-4 |
| 2.7 | References | 2-4 |

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# 2 Design Iteration

## 2.1 Introduction

2.1.1 This chapter provides a description of the site selection process and design iterations that were undertaken prior to arriving at the final design which is described in Chapter 3.

## 2.2 Background

2.2.1 The site is being developed by Douglas West Extension Ltd which is part of a family group of companies which also includes: 3R Energy, Mitchell Energy Ltd and William Mitchell & Sons Ltd of Hazelside Farm, Glespin (refer to Appendix 1.1. for further details).

2.2.2 As part of the same group of companies as the landowners of the neighbouring Hagshaw Hill and Douglas West Wind Farm sites, the Applicant proposes to construct the Proposed Development as part of a phased programme for redevelopment of the 'Hagshaw Cluster' (Hagshaw Hill Repowering and Extension and Douglas West Wind Farms, discussed further in Chapter 3) over the next five years.

## 2.3 Site Selection

2.3.1 William Mitchell & Sons Ltd and Mitchell Energy Ltd were contacted by a number of third party developers seeking to secure access over their land to develop an 'infill' wind energy development on the eastern part of Cumberhead Forest as an extension to the consented Douglas West Wind Farm (i.e. the Proposed Development). Following careful consideration 3R Energy and William Mitchell & Sons Ltd/Mitchell Energy Ltd concluded that there were many benefits in taking both the repowering of Hagshaw Hill Wind Farm and the Proposed Development forward themselves, as a local business, helping to sustain existing employment levels, maximise local benefits and keep income generated in the local area.

2.3.2 When viewing a map of wind farm developments in the local area, the Proposed Development site is apparent as an obvious gap in the middle of a wind turbine cluster. The physical extent of the site is limited by the existing and consented wind energy developments surrounding the site. The Proposed Development site boundary was therefore devised on this basis, and design iteration within that boundary then progressed (see below).

## 2.4 Alternative Sites

2.4.1 EIA legislation requires the consideration of alternatives and an indication of the reasons for selecting the site advanced, except, as noted in Planning Advice Note (PAN) 58, where limited by constraints of commercial confidentiality.

2.4.2 As noted above, the Proposed Development site is surrounded by either operational or consented wind developments. It is therefore considered to be a suitable site for wind energy development, making use of some existing site infrastructure and recognising the accepted principle of wind energy generation within the local landscape.

2.4.3 The Proposed Development site is considered an appropriate and viable location for a wind energy project due to:

- proven good average wind speeds and generation capacity, evidenced by the successful operation of the Existing Hagshaw Hill Wind Farm and Extension immediately to the south of the site since 1995, and the potential to achieve substantially greater electrical generation from the Proposed Development using modern turbines;

- being within an established wind farm landscape, where there is an opportunity to progress a coordinated layout, phasing, access, grid connection and landscape strategy for the future of the 'Hagshaw Cluster';
- there are no internationally, nationally or locally designated sites (landscape, ecology or cultural heritage) within the Proposed Development site;
- the site scores well in the recently published South Lanarkshire Council (SLC) Tall Turbines Guidance;
- easily accessible direct from the M74 without passing through any communities;
- ability to re-use a mining haul road and existing forestry tracks with minor upgrading;
- in close proximity to a viable grid connection point;
- can positively contribute towards regional and national renewable energy and carbon reduction targets;
- is capable of being delivered without public subsidy; and
- can provide a series of significant social and economic benefits for the local area.

## 2.5 Design Process

### *Design Principles*

2.5.1 Current best practice guidance provides a framework for the consideration of key design issues including turbine size, layout composition, wind farm design in relation to landscape character and designing for multiple wind farms (SNH, 2017).

2.5.2 The following principles were adopted during the design iterations made by the Applicant to ensure that the final design of the Proposed Development was the most suitable for the site:

- the Proposed Development should avoid inconsistent turbine spacing, such as relatively large gaps, outliers or excessive overlapping turbines to minimise visual confusion and ensure a balanced / compact array from key views;
- took account of the positioning of existing and consented wind energy developments in the local area from key views;
- consistency in turbine scale with consented and proposed developments in the immediate vicinity;
- retain a separation of at least 1 km from the closest isolated residential dwellings in the surrounding area;
- minimise impacts on the existing forestry resource and operations within the site;
- location of watercourses and ground conditions/topography;
- presence of power lines across the site; and
- other environmental constraints and associated buffers are to be respected.

### *Turbine Layout and Scale*

**Landscape & Generation Capacity**

2.5.3 The Applicant has considered a number of alternative layouts and turbine scales for the Proposed Development. Turbines ranging in tip height from 150 m to 200 m have been considered, based on the availability of modern turbine models and commercial viability of the project. Different rotor

diameters, and therefore turbine spacings to deal with wake effects, are applicable to the range of turbine scales considered. Therefore, a number of preliminary layout options were considered, for the range of turbine scales. The preliminary layouts took account of identified technical and environmental constraints based on desk- study and field survey work, as well as preliminary wind yield analysis.

2.5.4 Preliminary wirelines were generated for a range of turbine size and layout options, to assess the suitability of design with respect to visual effects on key receptors. Wireframes were generated for key viewpoints in the local landscape, each of which is a representative assessment viewpoint in the LVIA (Chapter 6). The Applicant's professional advisors produced and reviewed the preliminary wireframes and analysed the landscape capacity of the Proposed Development site (alongside the neighbouring Hagshaw Hill Repowering proposal), in order to advise on the most appropriate design to maximise renewable energy generation from the Cluster while not resulting in unacceptable landscape and visual effects. Regard was taken in this process to the other consented schemes in the landscape near to the site and the manner in which they would already serve to create a wind farm landscape in which the Proposed Development would be sited. The comparative wireframes which illustrate the range of turbine heights considered (150 m, 175 m, 200 m) are set out in Appendix 2.1.

2.5.5 The review established that the landscape had the capacity to accommodate turbines of up to 200 m without giving rise to effects on character or visual amenity that would greatly exceed those of the 150 m turbines consented at the adjacent Douglas West Wind Farm, in closer proximity to settlements and key viewpoints. As noted above, the site also scores well for accommodating taller turbines in SLC's recently published Tall Turbines Guidance, having 'medium capacity' for turbines between 150 – 200 m. Against this backdrop, the landscape review concluded that the Proposed Development would have a positive effect in terms of marrying the consented Douglas West Wind Farm on the lower ground with the Repowered Hasghaw Hill Wind Farm at the top of the hill (refer to Figure 1.4).

2.5.6 It is important to stress that optimisation of renewable electricity generation has been a key facet of the design iteration process. The optimal capacity of a turbine limited to 150 m or 175 m tip height (depending on assumed hub height), given the wind regime and economic considerations at this site, is approximately 3.8 to 4.3 MW, respectively. Therefore, a 13-turbine development at this site with 150 m turbines would likely have resulted in a total capacity of approximately 49.4 MW or approximately 55.9 MW for 175 m turbines, with annual generation anticipated to be in the order of 139 to 158 GWh. Using a larger, 6 MW turbine at 200 m to tip would result in a total site capacity of 78 MW, and annual generation in the order of 220 GWh. (In this regard it is noted that the higher tower height and correspondingly greater wind resource is necessary to justify the additional capital costs of the larger generators.)

2.5.7 As noted in paragraph 2.5.4 above, the review of different turbine scales and layouts established that turbines of 200 m would not give rise to effects on landscape character or visual amenity that would greatly exceed those of the 150 m turbines consented in the immediate vicinity. It is therefore considered that the potential additional generation capacity (58% more than for 150 m turbines and 39% more than for 175 m turbines) within the same site area and from the same number of turbines – also resulting in up to £143,000 per year more community benefit – would greatly outweigh any slightly increased landscape and visual effects resulting from the installation of 200 m, instead of 150 m or 175 m turbines. For these reasons, the Applicant elected to proceed with the Proposed Development with a maximum tip height of 200 m.

**Forestry**

2.5.8 An important factor taken into the design and positioning of the final turbine layout has been the existing forestry resource across the site. Where possible turbines were micro-sited to minimise the number of forestry blocks that required clear felling as part of the Proposed Development. Further assessment of the potential effects on the commercial forestry operation is provided in Chapter 16.

2.5.9 The design also took into consideration the recommended bat habitat standoff distances from blade swept path to key habitat features (woodland edge/ tree top) (Natural England, 2014). Turbines will

be 'keyholed' within the replanted commercial forest and 20 m wayleaves placed around access tracks and the substation area. A tip height of up to 200 m also reduced the keyhole area by virtue of increasing the rotor clearance above the tree canopy therefore reducing the impacts upon the existing forestry operations.

### *Access Tracks and Crane Hardstandings*

2.5.10 On confirmation of the proposed turbine layout, AECOM undertook site walkovers and assessments of site topography, ground conditions and watercourses in order to establish a suitable design for the site access, on-site access tracks and crane hardstandings.

2.5.11 The site benefits from existing access direct from the M74 Junction 11, along an existing tarmac haul road and then into the main body of the Proposed Development site. The on-site tracks are also in part defined by existing infrastructure (forestry tracks), including the construction access route for the operational Nutberry Wind Farm to the west of the site.

2.5.12 Proposed new tracks have been designed to take into account existing wayleaves between forest blocks in order to reduce impacts on the commercial forestry operations and are also based on site topography, ground conditions and to minimise and appropriately locate water crossings.

### *Substation and Construction Compounds*

2.5.13 The proposed substation location, which will also incorporate an energy storage facility, is at the entrance to the main development area, providing best access to grid infrastructure. The proposed main construction compound and laydown area are also located at the entrance to the main development area to optimise construction activities and minimise impact on the forest. (Refer to Figure 1.3.) All have been sited to avoid watercourses and sensitive habitats.

## 2.6 Summary

2.6.1 The final Proposed Development layout has been informed by a robust 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 baseline data, review of preliminary visualisations, ongoing impact assessments, and wind yield optimisation.

2.6.2 The final turbine layout and scale has been designed to maximise renewable energy generation from the site, whilst keeping within acceptable limits for potential impacts on the environment.

2.6.3 The EIA Report is based on the final layout selected for the Proposed Development. The final layout comprises 13 turbines of up to 200 m in height and associated access tracks and crane hardstandings, substation and energy storage facility, underground electrical cabling, construction compounds, laydown area, borrow pit workings, and two meteorological masts.

2.6.4 It is acknowledged that in practice every wind farm site has some local impact; however, in both a national and regional context the Proposed Development is considered to represent an excellent opportunity for an appropriately designed renewable energy development that is capable of delivering significant renewable energy generation without public subsidy.

## 2.7 References

Natural England (2014). Bats and onshore wind turbines: interim guidance. Third Edition TIN051.

Scottish Government (1999). Planning Advice Note (PAN) 58: Environmental impact Assessment.

SNH (2017). Siting and Designing Wind Farms in the Landscape, Version 3a