



White Hill Wind Farm

Environmental Impact Assessment Report

Chapter 2: Assessment of Project Alternatives

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2.1 Introduction

The presentation and consideration of the various reasonable project alternatives investigated is an important requirement of the EIA process and the single most effective means of avoiding likely significant effects on the environment. The purpose of this chapter is to document the assessment of the range of alternatives considered in the design process and the main reasons for selecting the development, as proposed.

2.2 Requirements of the EIA Directive

EIA Directive 2014/52/EU requires that an EIA must include:-

'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 environmental effects'.

This provision requires an EIA to present transparent and objective evidence on the range of reasonable alternatives which were examined, analysed and evaluated as part of the iterative EIA and project design decision-making processes, and which led to the adoption and selection of the final project as described in **Chapter 3**.

The *Guidelines on the Information to be Contained in Environmental Impact Assessment Reports* (EPA, 2022) state that it is generally sufficient to provide a broad description of each main alternative, identifying the key issues associated with it, and to demonstrate how environmental considerations were taken into account. A detailed assessment (or 'mini-EIA') of each alternative is not required.

2.3 Alternatives Considered

The consideration of project alternatives is a dynamic process and alternatives may be identified at many levels and stages during the evolution of a project, from strategic site selection through to site layouts, design, technologies and on to mitigation and any monitoring measures. Alternatives that are available for consideration at the earlier stages in the evolution of a project are considered to represent the greatest opportunity for the avoidance of likely significant effects on the environment.

The reasonable alternatives considered in undertaking this EIA were therefore as follows:-

- 'Do Nothing' alternative;
- Alternative locations;
- Alternative technologies;
- Alternative design and layouts;
- Alternative grid connections;
- Alternative haul routes; and
- Alternative forestry replant lands.

Each of these alternatives were considered relevant to the project and its specific characteristics and are discussed in further detail below, including an assessment and comparison of likely significant environmental effects, and indicating the main reasons for choosing the development, as proposed.

2.4 Assessment of Alternatives

2.4.1 'Do-Nothing' Alternative

Current national Government policy in respect of energy production and the reduction of anthropogenic greenhouse gas emissions are all collectively strongly supportive of the increased generation of renewable electricity, including wind energy generation, to rapidly reverse climate breakdown and the transition of energy production away from fossil fuels.

The current Programme for Government commits to an average 7% per annum reduction in overall greenhouse gas emissions from 2021 to 2030 (c. 51% reduction over the decade) and to achieving 'net-zero' emissions by 2050. This has recently been legislated for in the Climate & Low Carbon Development (Amendment) Bill 2021 and is one of the most ambitious decarbonisation pathways anywhere in the world. The Programme for Government also commits to a renewable energy target of at least 70% by 2030.

The Climate Action Plan 2021 further increases the renewable energy generation target to 80% by 2030. The Climate Action Plan recognises that onshore wind energy developments will continue to be the predominant means of achieving this target, with an estimated 8-gigawatts (GW) being generated from such developments.

The Government's *Wind Energy Development Guidelines for Planning Authorities 2006* (DoEHLG, 2006) and subsequent updated *Draft Revised Wind Energy Development Guidelines 2019* (DoHPLG, 2019) establishes a land-use planning framework whereby planning authorities can proactively support the development of wind energy projects at appropriate locations. In accordance with these land-use policies, the *Carlow County Development Plan 2022-2028* and the *Kilkenny City & County Development Plan 2021-2027* are supportive of wind energy development at suitable locations within County Carlow & County Kilkenny.

In the 'Do Nothing' alternative, the *status quo* in terms of the local environment would continue, as gradually evolving managed farmland and maturing commercial forestry. It is also likely that in the 'Do-Nothing' scenario, there would be some further commercial afforestation.

The quantum of renewable energy produced in County Carlow and County Kilkenny would also remain unchanged. Therefore, due to the critical importance of onshore wind energy in the transition to a low carbon economy in national and local policies and the recognised imperative of generating electricity from renewable sources, as outlined above, the 'Do Nothing' alternative was not considered a viable option.

It was considered that there is significant potential within County Carlow, to deliver further wind energy generation capacity. At present, according to the *Carlow County Development Plan 2022-2028*, the total installed wind energy capacity is 5.8MW¹; while it is separately noted that a further c. 22MW has been permitted (Bilboa Wind Farm²) within the county but is not, at the time of writing, operational. In

¹ Since the publication of the *Carlow County Development Plan 2022-2028*, we are aware of a further single turbine development (Carlow County Council Planning Register References 13/322 [An Bord Pleanála Reference PL01.243964], 19/463, and 20/46), with an output of 660kW (0.6MW), having been commissioned.

² Carlow County Council Planning Register Reference 11/154 (An Bord Pleanála Reference PL01.240245). It is also noted that planning permission is currently being sought to revise the turbine type to be installed at the Bilboa Wind Farm which would, if permitted, increase its overall capacity to 22.5MW.

addition, the Croaghaun Wind Farm³, with an approximate electrical capacity of 38.5MW and for which planning permission was refused by Carlow County Council, and the Kildreenagh Single Wind Turbine⁴, with an approximate electrical capacity of 500kW (kilowatts)(for which permission was granted by Carlow County Council), are currently before An Bord Pleanála on appeal.

According to the *Kilkenny City & County Development Plan 2021-2027*, there are currently 39 no. wind turbines located within Co. Kilkenny with a capacity of c. 76MW. We are also aware of the 8 no. wind turbine Lisheen III Wind Farm which is, at the time of writing, under construction with an approximate capacity of 29MW⁵.

Accordingly, given the strong planning policy support for the generation of renewable energy at appropriate locations and the clear requirement for additional renewable energy generation to reduce greenhouse gas emissions, it was concluded that the 'Do-Nothing' option was not assessed to be a reasonable alternative.

2.4.2 Alternative Technologies

Wind energy is recognised in Government policy as a proven and cost-effective renewable energy generation technology in the context of Ireland's abundant wind resource. The only other terrestrial technology reasonably available that could possibly meet the objectives of the project would be the development of a photovoltaic solar energy project.

Solar energy production requires a significantly larger direct land-take and would result in substantial changes to existing agricultural practices. In contrast, a wind energy project will not result in any substantive alteration to current land uses and agricultural activities can co-exist and continue with only minor disturbance during the construction phase. For example, a 7.2MW wind turbine (and ancillary structures) is estimated to require a direct land-take of c. 1 hectare (2.5 acres) while a solar development with an output of 7.2MW would require a footprint area of c. 12 hectares (29 acres). As such, the comparable land-take for a solar energy project (of an equivalent installed capacity) required to meet the objectives of the project would have a direct footprint of c. 85 hectares thus substantially altering existing land-uses and agricultural practices.

Evidently, a wind energy development would result in a substantially reduced level of disturbance to existing agricultural activities and consequential loss of land from agricultural production, alongside reduced potential impacts on local habitats due to land use changes, in comparison to a similarly scaled solar development.

Moreover, a solar energy project would not generate renewable electricity in a similarly efficient manner as a wind energy development. The *Renewable Electricity Support Scheme (RESS) High Level Design*, published by the Government of Ireland, considers that onshore wind has a generating capacity of 31% while solar PV has a capacity factor of 11%; thus illustrating the substantially greater efficiencies offered by onshore wind energy developments compared to solar energy developments.

³ Carlow County Council Planning Register Reference 21/13 (An Bord Pleanála Reference ABP-309937-21)

⁴ Carlow County Council Planning Register Reference 21/254 (An Bord Pleanála Reference PL01.314517)

⁵ We are also aware of the Castlebanny Wind Farm, located within Co. Kilkenny, which was granted planning permission by An Bord Pleanála (Reference ABP-309306-21) in September 2022. The capacity of the Castlebanny Wind Farm will range between 105MW and 126MW depending on the precise turbine model installed.

Wind energy production in Ireland is very effective due to the large available wind resource and mature cost-effective technologies. Therefore, a solar energy project would be significantly less competitive in an auction process in obtaining a grid connection offer from the Commission for the Regulation of Utilities, Water and Energy (CRU). On this basis, other technologies were considered inferior and not considered a viable alternative to achieve the objectives of the project.

2.4.3 Alternative Locations

Strategic site selection to avoid intrinsic environmental sensitivity is the principal mitigation option for onshore wind energy projects. Some locations have more inherent environmental sensitivities than others and an assessment of alternative locations can avoid such locations in favour of locations which have fewer constraints and more capacity to sustainably assimilate the project.

There is a well-established and widely used methodology for the selection of wind energy development locations used by developers. The methodology is based on a screening process and applying key sieve analysis criteria (not listed in order of importance), as follows:-

- Available wind resource;
- Land use context;
- Electricity grid availability and capacity;
- Residential amenity and community;
- Environmental constraints (including natural and archaeological heritage);
- Landscape and visual capacity;
- Accessibility;
- Energy and land-use planning policies; and
- Other Factors.

In assessing alternative locations, the Developer has been particularly cognisant of the policies and objectives of the *Carlow County Development Plan 2022-2028* and the *Kilkenny City & County Development Plan 2021-2027* (and their respective predecessor plans) including the Strategic Environmental Assessment (SEA) prepared for each plan in accordance with Directive 2001/42/EC. SEA is a form of environmental assessment decided upon at a higher administrative level, and adopted by the Planning Authority.

Within the *Carlow County Development Plan 2022-2028*, the Renewable Energy Strategy fails to provide specific direction or a wind strategy map which clearly conveys the location of suitable wind energy development areas in the county. The Renewable Energy Strategy simply indicates that there are 2 no. locations within the county designated 'Not Normally Permissible' but fails to identify any locations where wind energy developments should be directed (i.e. 'Preferred Locations') or areas where such development may be acceptable subject to compliance with prevailing national policy or guidance (i.e. 'Areas Open to Consideration').

By comparison, the *Kilkenny City & County Development Plan 2021-2027*, at Figure 8 of Appendix K, clearly identifies locations where the development of wind energy projects would be 'Acceptable in Principle', 'Open for Consideration', and 'Not Normally Permissible'. The planning policy direction provided in this map, in combination with its predecessor (Figure 10.2 of the *Kilkenny County Development Plan 2014-2020*), was crucial in the assessment of alternative locations.

Accordingly, an assessment of all reasonable alternatives relevant to the project

and its specific characteristics was undertaken as part of this EIAR process and based on the abovementioned criteria together with the general criteria included in the *Wind Energy Guidelines for Planning Authorities 2006* and the *Draft Revised Wind Energy Development Guidelines 2019*.

On the basis of this assessment, 2 no. possible areas were identified as potentially suitable for the development of a wind energy project, as follows:-

- **Option L1:** Tentore, Freshford, County Kilkenny; and
- **Option L2:** Knockabranagh & Knockbaun, Co. Carlow, and Coolcullen, Co. Kilkenny.

Both of these locations were consequently selected for further detailed technical and environmental assessment, as described below. The alternative locations are illustrated below at **Figure 2.1** and reproduced at **Annex 2.1**.

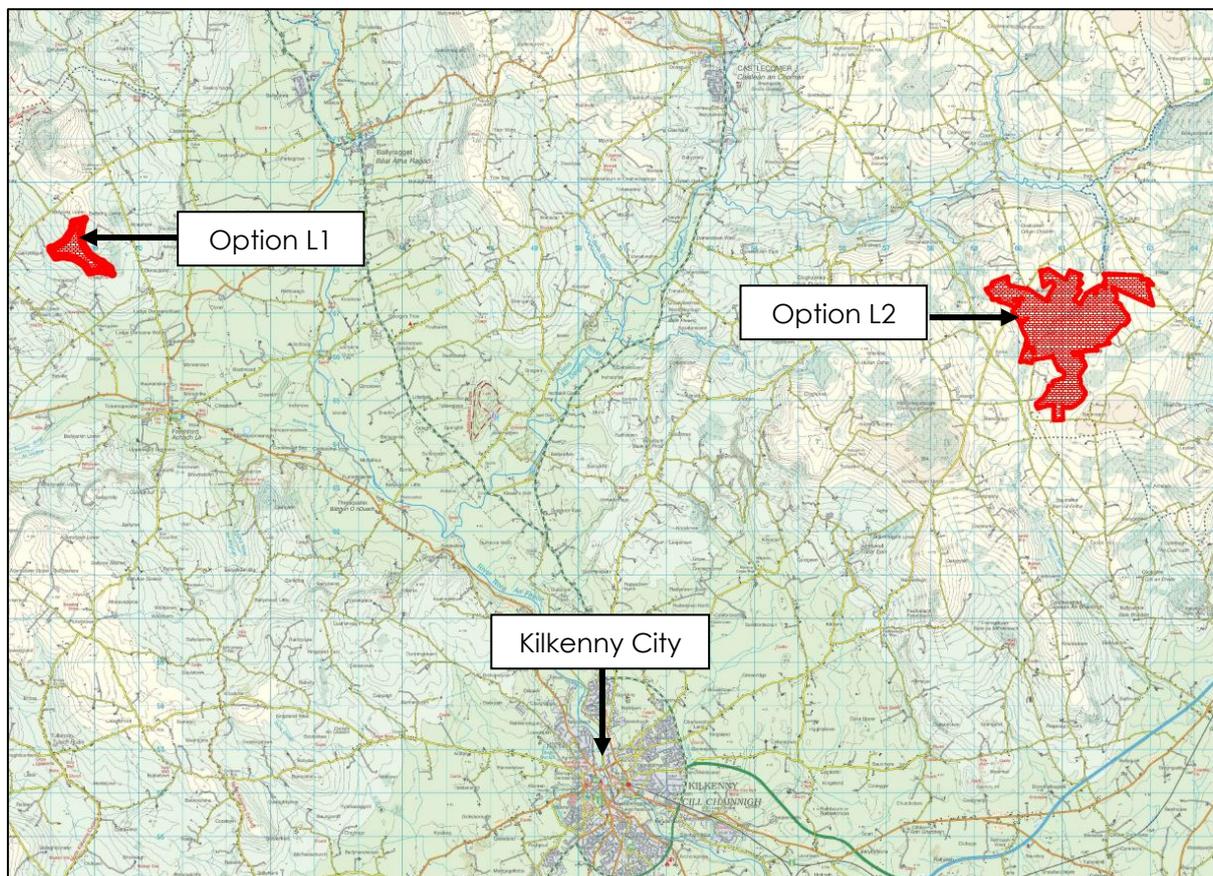


Figure 2.1: Alternative Locations

Table 2.1 below provides an overview of a comparative assessment of environmental constraints and opportunities associated with both alternative locations and the emerging preferred location based on each environmental factor. In undertaking this assessment, the criteria provided in Schedule 7 of the Planning & Development Regulations 2001 (as amended) together with the general environmental factors included in Article 3(1) of the EIA Directive were used as a framework for analysis.

Location	Option L1	Option L2	Emerging Preferred Option
Factor			
Population & Human Health	Low density of dwellings in vicinity of identified location; however, notable levels of residences along local routes. Approximately 4km to the nearest urban settlement (Freshford).	Low density of dwellings in vicinity of identified location; with substantial separation distances to wind turbines being achievable. Approximately 4km to the nearest urban settlement (Oldleighlin).	Option L2
Biodiversity	Identified site is generally not sensitive and primarily comprises intensively farmed pasture. There are a number of Natura 2000 sites within 10km including the River Nore Special Protection Area (SPA), the River Barrow & River Nore Special Area of Conservation (SAC), Cullahill Mountain SAC, and Spahill & Clomantagh Hill SAC. The identified site exhibits a hydrological connection to the River Barrow & River Nore SAC via the Ballyring Upper stream, located to the west of the subject lands.	Identified site is generally not sensitive and primarily comprises intensively farmed pasture and commercial forestry plantation. The River Barrow & River Nore SAC is located c. 1.5km to the north, while the Knocknabranagh & Knockbaun stream (also referred to as the Coolcullen River), located within the identified location, provides a hydrological connection and potential pathway for effects.	Option L1 or Option L2
Land & Soil	The identified site is predominately underlain by shales and sandstone tills with bedrock also being at or near the surface.	Evidence of peat to the east of identified location but predominately underlain by shales and sandstone till.	Option L1 or Option L2
Water	No watercourses identified within the subject lands. As stated above, the adjacent Ballyring Upper stream provides a hydrological connection to the River Barrow & River Nore SAC.	2 no. lower order watercourses identified within this location; but no major watercourses present. As stated above, the Knocknabranagh & Knockbaun stream provides a hydrological connection to the River Barrow & River Nore SAC.	Option L1
Air Quality & Climate	No constraints identified. Development would result in a positive overall impact.	No constraints identified. Development would result in a positive overall impact. It is noted that the greater spatial extent of this option, compared to Option L1, offers increased potential for a greater quantum of renewable energy to be	Option L2

		generated thus increasing the corresponding reduction in the requirement for fossil-fuel generated electricity.	
Landscape	The identified location is located within the 'Slievearadagh Hills (North & South)' landscape character area. This area is classified as 'Uplands' and contains a number of protected views to the west of the identified lands. It is noted that the prospect of the protected views are to the north and, notably, to the east towards the identified lands.	<p>Within Co. Carlow, the identified location is located within the Killeshin Hills landscape character area. While this landscape character area contains a number of protected views and prospects, the vistas are directed away from the identified location and towards the lowlands to the east and south.</p> <p>In Co. Kilkenny, the identified location is located within the Castlecomer Plateau landscape character area. This area is classified as 'Uplands' and contains a number of protected views. Again, it is noted that these vistas are generally directed towards the lowlands to the north, west and south and away from the identified location.</p>	Option L2
Cultural Heritage	1 no. cultural heritage feature located adjacent to the identified location. Low number of features in the vicinity.	1 no. cultural heritage feature located adjacent to the identified location. Low number of features in the vicinity.	Option L1 or Option L2
Noise & Vibration	Due to the limited number of receptors (dwellings) in the vicinity and available separation distances, likely effects are assessed as low.	Due to the limited number of receptors (dwellings) in the vicinity, and available separation distances, likely effects are assessed as low. It is, however, assessed that increased separation distances can be achieved at this location when compared to Option L1.	Option L2
Shadow Flicker	Due to the limited number of receptors (dwellings) in the vicinity and available separation distances, likely effects are assessed as low.	Due to the limited number of receptors (dwellings) in the vicinity, and available separation distances, likely effects are assessed as low. It is, however, assessed that increased separation distances can be achieved at this location when	Option L2

		compared to Option L1.	
Material Assets (Transport & Access; Aviation; and Telecommu- -nications)	No significant effects likely on transport. Location can be accessed via public road (national, regional and local routes); however, it is noted that significant upgrade works may be required to accommodate abnormal loads e.g. in Durrow, Co. Laois. Existing telecommunication masts in wider vicinity of identified location but effects not likely to be significant.	No significant effects likely on transport. Location can be readily accessed via national, regional and local roads with some modest upgrade works. Existing telecommunication masts in wider vicinity of identified location but effects not likely to be significant.	Option L2

Table 2.1: Environmental Assessment of Alternative Locations

Based on this analysis, it was determined that, although both locations were generally suitable, Option L2; located generally at Knocknabranagh and Knockbaun, Co. Carlow and Coolcullen, Co. Kilkenny; was the emerging preferred location from an environmental constraints and opportunities perspective for the following reasons:-

- The land use context is benign, generally consisting of flat or gently undulating pastoral farmland or commercial forestry plantation with access to a suitable land bank;
- The location has a generally low population density, with a low number of residential properties and appropriate setback distances available to dwellings. The *Draft Revised Wind Energy Development Guidelines 2019* propose a setback distance of 4-times overall tip height between a wind turbine and the nearest point of the curtilage of any residential property, subject to a mandatory minimum setback of 500m. These setback distances can be achieved at this location for all non-involved (third party) dwellings;
- The general absence of sensitive nature habitats and the absence of any European sites (Natura 2000) or other national nature conservation designations on, or in the immediate vicinity, of the location. The nearest Special Area of Conservation (SAC) is the River Barrow & River Nore SAC (Site Code: 002162) located c. 1.5km to the north. The nearest Special Protection Area (SPA) is the River Nore SPA (Site Code: 004233) located c. 13km to the west;
- The location is not the subject of any specific protective landscape designations under the provisions of the *Carlow County Development Plan 2022-2028* or the *Kilkenny City & County Development Plan 2021-2027*;
- The location is well served by the national road network, with the M9 motorway located c. 5km to the east of the identified location and the N78 located c. 10km to the north. From the national road network, the location is served by good quality locally-classed roads. A network of local roads traverse the general area and could be utilised during the construction and operational phases of development. Road upgrades to accommodate the delivery of turbine components would be necessary; however, these would not be significant or extensive; and
- The absence of any particular cultural heritage constraints.

Importantly, from a technical and commercial viability perspective, Option L2 has an estimated wind speed of approximately 7.8m/s at 104m height (adjusted; as derived from the existing meteorological mast installed at this location) which is sufficient to ensure the viability of a wind energy development. Furthermore, the strategic location of Option L2 provides for a range of alternative locations for connecting to the national electricity network (see **Section 2.4.5** below for further details).

On the basis of this assessment, it was decided to undertake further analysis of Option L2 while discontinuing further analysis of Option L1 as a reasonable alternative.

2.4.4 Alternative Design & Layouts

Following the identification of Option L2 as the preferred location, an iterative process was undertaken to determine the precise siting, design and layout of the wind turbines and associated infrastructure. A number of alternative layouts were evaluated to consider how different elements of the project could be arranged such that there would be no likely significant effects on the environment.

The aim was to adopt the combination of design and layout options that presents the best balance between the avoidance of likely significant environmental effects and the achievement of the objectives of the project. The process involved an ongoing dialogue between technical designers and competent environmental experts throughout the design process, with the designers adjusting the design in response to continued environmental evaluation. Feedback from the scoping process, including public and stakeholder consultation discussed in **Chapter 1**, also informed this process.

The assessment of alternative designs and layout, which involved a series of repeated steps, each involving design and re-design, was focused on achieving the best balance with regards to a wide range of environmental factors. This continuous assessment was intrinsic to the selection of the final design and layout of the project. The alternative layouts considered were highly dependent on the specific turbine technology to be installed, with larger turbines requiring increased inter-turbine spacing to minimise wake effects and maintain correct operational performance. A series of wind modelling analyses, using specialist software, examined a range of site layouts and turbine designs to establish turbine technology, including hub, rotor and overall height parameters. These iterations were particularly influenced by the following localised environmental considerations:-

- Visual impact;
- Inter-visibility/visual clutter;
- Avoidance of telecommunications links present at the general location; and
- Setback to existing/permitted residential dwellings.

The location of ancillary wind farm infrastructure; including crane hardstands, access tracks, site entrances and underground cabling; is intrinsically linked to the precise layout of wind turbines and the volume of ancillary infrastructure increases proportionally with the number of turbines proposed. The routing of access tracks is highly flexible, is closely linked to the siting of wind turbines and can be altered to reflect any changes to turbine locations or identified environmental constraints. Through the iterative turbine design and layout process outlined above, including site constraint mapping, the most appropriate access track routes were identified for each alternative considered, taking into account the presence of existing

agricultural tracks and field boundaries, and, insofar as possible, to reduce the overall project footprint.

Consideration was firstly given to the size and height of the turbines to be developed, including a project comprising of a larger number of small-to-medium sized turbines with an overall tip height of c. 105m. Given the relatively low numbers of dwellings within the local vicinity, it was considered possible to achieve appropriate dwelling setback distances to dwellings and to install a large number of smaller turbines. A comparable example of such a development would be the Mountain Lodge/Bindoo/Edrans/Carrickallen wind farm complex in County Cavan where a total of 65 no. turbines are currently in operation generating a total output of 103MW. This wind energy complex has a large spatial extent and covers an area of c. 1,135 hectares.

Having assessed the availability of land with Option L2, it was considered that the location could accommodate up to 15 no. wind turbines of up to 105m in height with an electrical output of c. 22MW. However, a project with a smaller number (7-10 no.) of larger turbines of up to 185m in height could, on the other hand, generate between approximately 50MW-70MW with a much smaller physical footprint and spatial extent. Installing larger turbines with a smaller footprint would result in a considerably reduced likelihood of significant environmental effects; particularly in respect of likely landscape, noise and shadow flicker impacts; and substantially more efficient renewable energy generation output.

The results of these analyses determined that, having regard to the proposed project objectives and its specific locational characteristics, two main project design options could be reasonably considered from a technical and environmental perspective, as follows:-

- **Option D1:** 8 no. turbines with a maximum tip height of up to 170m (c. 35MW); and
- **Option D2:** 7 no. turbines with a maximum tip height of up to 185m (c. 51MW).

The layout of each option is provided at **Figure 2.2** and **Figure 2.3** below, and reproduced at **Annex 2.2**.

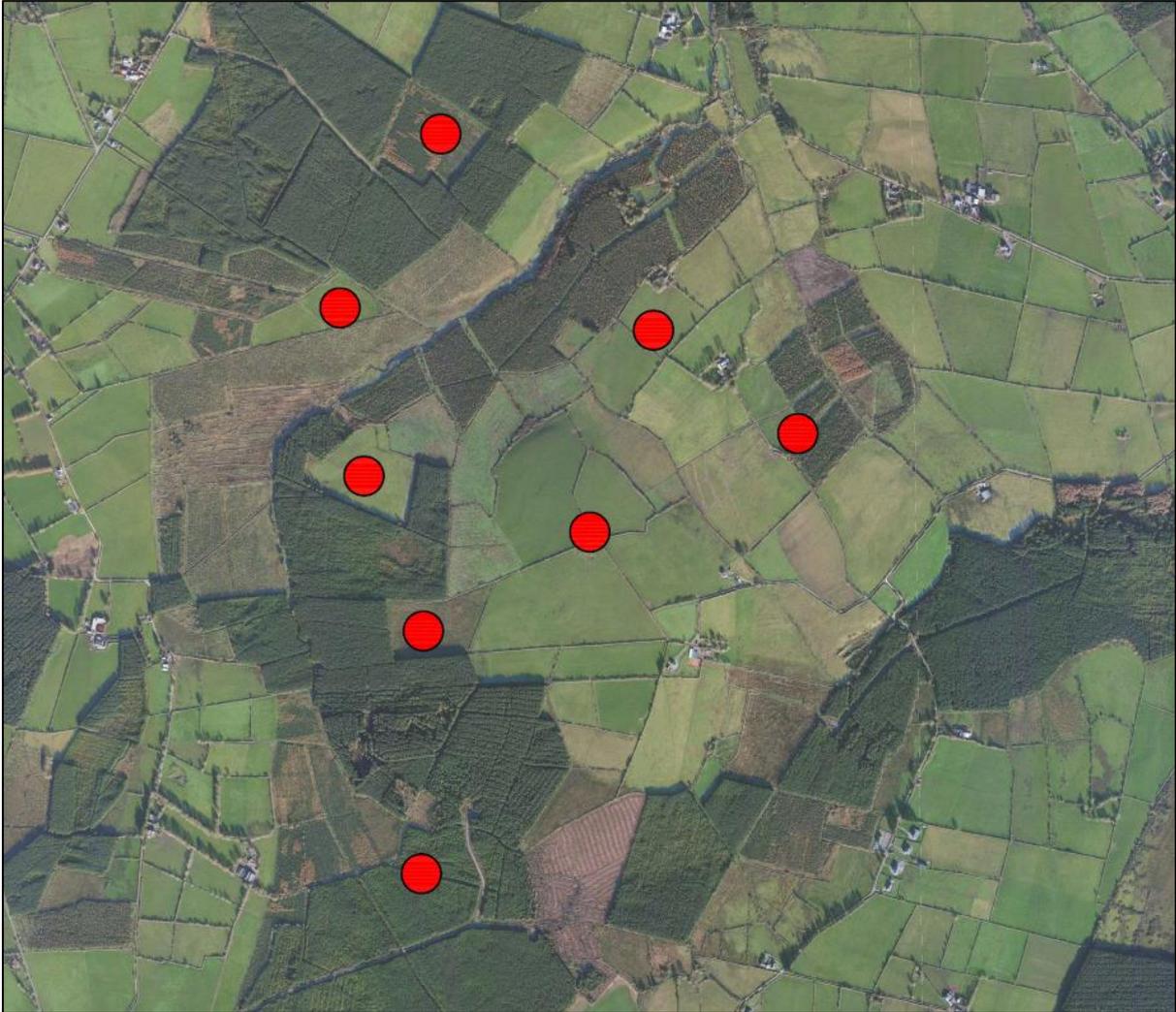


Figure 2.2: Option D1 Site Layout (8 Turbines, Maximum Height 170m, 38MW)

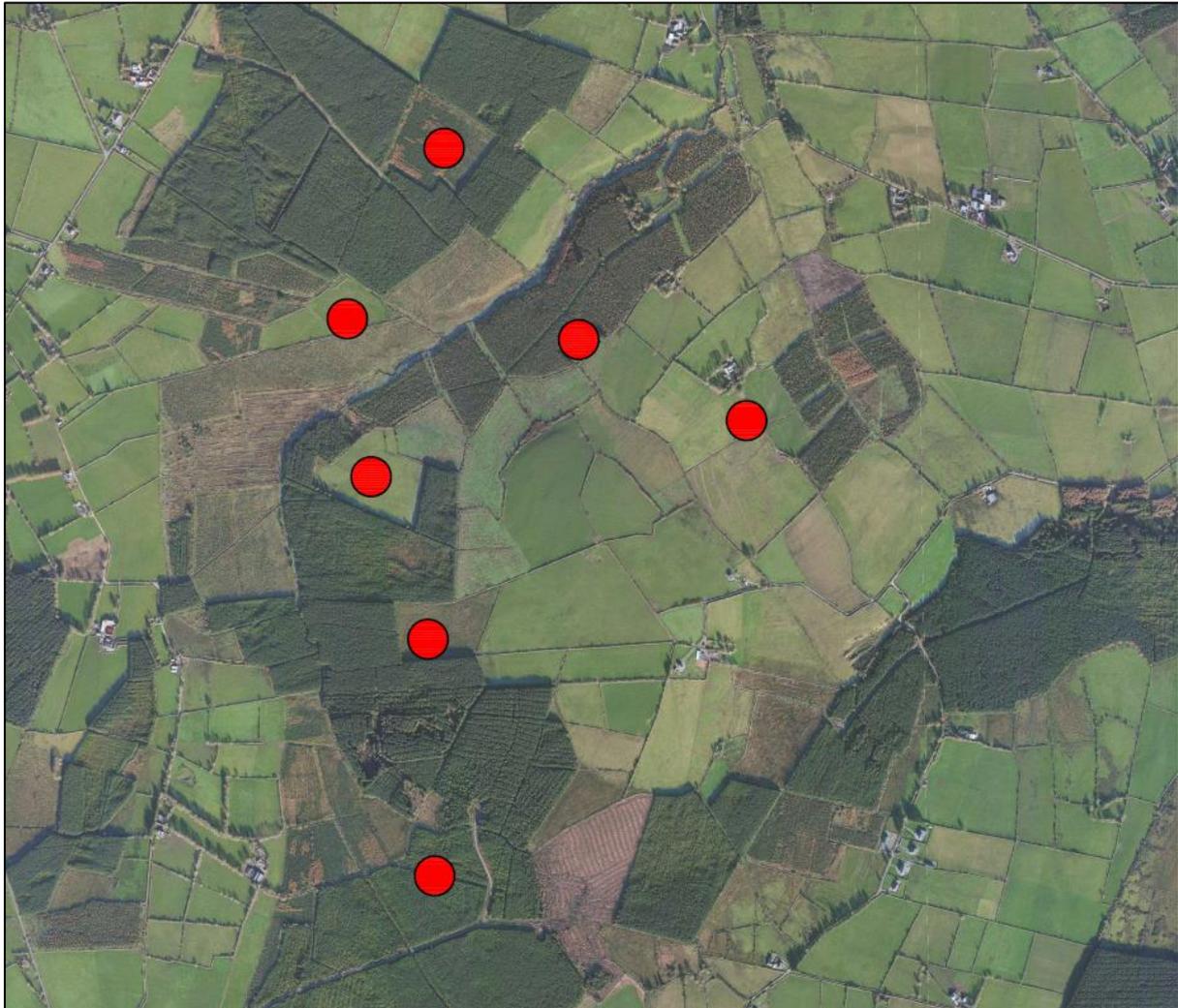


Figure 2.3: Option D2 Site Layout (7 Turbines, Maximum Height 185m, 51MW)

Table 2.2 provides an overview of the environmental constraints, and opportunities, associated with each of the two identified options and provides a recommendation of the emerging preferred option based on each environmental factor. Again, in undertaking this assessment, the criteria provided in Schedule 7 of the *Planning & Development Regulations 2001 (as amended)* together with the general environmental factors included in Article 3(1) of the EIA Directive were used as a framework for analysis.

Design & Layout	Option D1	Option D2	Emerging Preferred Option
Factor			
Population & Human Health	Low number of dwellings in vicinity of turbines; 3 no. dwellings within '4-times tip height' of a wind turbine.	Low number of dwellings in vicinity of turbines; 2 no. dwellings within '4-times tip height' of a wind turbine.	Option D2
Biodiversity	Substantial removal of vegetation likely to be required including hedgerow and commercial forestry. Turbine layout generally	Reduced level of vegetation removal compared to Option D1 and the extent of development/works in higher value habitats is reduced.	Option D2

	avoids surface water features; however access tracks will be required to cross watercourses which are hydrologically connected to the downstream River Barrow & River Nore SAC.	Turbine layout avoids watercourses; however access tracks will be required to cross watercourses which are hydrologically connected to the downstream River Barrow & River Nore SAC.	
Land & Soil	No likely significant effects identified. Some infrastructure may be located adjacent to mapped areas of localised/shallow peat.	No likely significant effects identified. Some infrastructure may be located adjacent to mapped areas of localised/shallow peat.	Option D1 or Option D2
Water	No particular constraints identified. A number of crossings required over watercourses which discharge to the River Barrow & River Nore SAC.	No particular constraints identified. A number of crossings required over watercourses which discharge to the River Barrow & River Nore SAC.	Option D1 or Option D2
Air & Climate	No constraints identified. Development would result in a likely positive overall environmental impact.	No constraints identified. Development would result in a likely positive overall environmental impact.	Option D1 or Option D2
Landscape	No protected landscape designations or designated scenic views in immediate vicinity.	No protected landscape designations or designated scenic views in immediate vicinity. Visual impact likely to be less than Option D1, notwithstanding the increased overall height, due to reduced number of turbines and reduced likelihood of visual clutter.	Option D2
Cultural Heritage	No significant effects likely.	No significant effects likely.	Option D1 or Option D2
Noise & Vibration	No likely significant effects identified due to the substantial setbacks to the nearest dwelling.	No likely significant effects identified due to the substantial setbacks to the nearest dwelling. Increased separation distance are achievable compared to Option D1.	Option D2
Shadow Flicker	No likely significant effects identified due to the substantial setbacks to the nearest dwelling.	No likely significant effects identified due to the substantial setbacks to the nearest dwelling. Increased separation distance are achievable compared to Option D1.	Option D2
Material Assets	No significant effects likely on transport. Location can be	No significant effects likely on transport. Location can be	Option D2

(Transport & Access; Telecommunications)	readily accessed via national, regional and local roads with some modest upgrade works. During consultation with service providers, a risk of interference with existing telecommunication links was identified.	readily accessed via national, regional and local roads with some modest upgrade works. During consultation with service providers, a risk of interference with existing telecommunication links was identified. However, the reduced number of turbines provides for increased re-design options, and a greater range of mitigation measures, to avoid significant effects.	
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Table 2.2: Environmental Assessment of Alternative Site Designs and Layouts

Based on this appraisal, it was concluded that Option D2 (7 no. turbines) was the emerging preferred project design and layout for the following reasons:-

- A substantially greater volume of renewable electricity can be generated from a reduced number of slightly larger turbines while reducing the likelihood of significant environmental effects particularly in respect of Biodiversity, Landscape, Noise & Vibration, Shadow Flicker, and Material Assets;
- The reduction in turbine numbers, and consequently ancillary infrastructure, minimises the interaction between construction activities and ecological receptors. In particular, the extent of hedgerows and other habitats which would otherwise have been disturbed have been reduced;
- A reduced number of turbines will reduce the likelihood of adverse air quality effects (i.e. temporary dust impacts and vehicular movements etc,) which may arise during the construction phase due to the reduced requirement for excavations, plant & machinery, and materials to be brought to site;
- A reduced number of turbines significantly reduces the direct footprint of the project and, consequently, the likelihood of significant visual impacts. The generous intra-turbine spacing also reduces the likelihood of visual clutter and is evaluated to be more appropriate in this landscape;
- The limited spatial extent of the project and regular spacing between turbines (in response to field patterns) accords with Section 6.9.2 of the *Wind Energy Development Guidelines for Planning Authorities 2006* and *Draft Revised Wind Energy Guidelines 2019* for 'Hilly and Flat Farmland' landscape character types;
- Option D2 provides for greater separation between wind turbines and residential dwellings thus reducing the likelihood of significant noise, vibration, and shadow flicker effects; and
- A consolidated project of 7 no. turbines will require fewer materials (e.g. aggregates and concrete) to be imported to the site. Therefore, fewer vehicular movements will be required during the construction phase thus reducing the likelihood of significant effects on the local road network.

While the assessment of alternative site designs and layouts was predominately focussed on an appraisal and evaluation of specific on-site environmental constraints; it should be noted that matters raised by members of the local community, through the community consultation process, were also an important factor in the consideration of alternative site designs. In particular, a number of local residents advised that the wider area was important for drinking water supplies while concerns were also raised regarding visual impact, noise, and shadow flicker. The

local knowledge of the site, and the concerns raised, were central to the above assessment and enabled the project team to fully consider and assess alternatives which responded to the characteristics of the site and the comments provided by third parties.

Subsequent to the conclusion that Option D2 was the emerging preferred project design and layout, a technical appraisal of available turbine technology was carried out to determine which turbine model was optimal for the site.

Turbine models, which could be provided within the overall tip height of 185m were considered, include the following:-

- Nordex N163-6.0;
- Vestas V162-7.2;
- Vestas V162-6.2;
- General Electric GE 5.8-158; and
- Siemens Gamesa SG 6.0-155.

Each of these turbine models were deemed to be generally suitable for installation at the subject site. However, based on the analysis undertaken, the Vestas V162-7.2 was considered to be the most suitable for the site and was selected as the turbine model for the project (see **Chapter 3** for further details).

2.4.5 Alternative Grid Connections

The method of connection to the national electricity grid is also an integral element of the overall project which falls to be considered in the EIAR.

In Ireland, the point of connection to the national grid is determined by way of a separate and subsequent statutory process under the auspices of EirGrid/ESB Networks as grid network operators. While it cannot be determined with complete certainty as to the precise mode of connection to the national grid; following a detailed technical analysis by the Developer, including an assessment of the existing grid network and grid capacity in the region and the predicted electrical output of Option D2, it is considered that connection to an existing electricity substation, as opposed to the construction of a new substation, is the most likely method of connection.

Following this determination, a technical evaluation was completed to identify suitable substations to which to connect and the most suitable method of providing this connection. Subsequently, an extensive environmental assessment was undertaken to identify the most suitable location and siting for this infrastructure to minimise, by design, the likelihood of significant adverse effects. As a result of this analysis, 2 no. grid connection options were identified as being generally viable alternatives, as follows:-

- **Option G1:** Construction of a 38kV substation at the wind farm site and installation of a 38kV underground electricity line, within the carriageways of local and regional public roads, to the existing Kilkenny 110kV substation, which is located approximately 11km to the southwest; and
- **Option G2:** Construction of a 38kV substation at the wind farm site and installation of a 38kV underground electricity line, within the carriageways of local and regional public roads, to the existing Kellistown 220kV substation, which is located approximately 20km to the northeast.

Other substations on the national grid, such as the existing Graigue 38kV substation in Carlow Town, the 38kV substation in Castlecomer (Co. Kilkenny) and

Bagenalstown 38kV substation (Co. Carlow) were not considered to be reasonable alternatives to connect the project to the national grid due to the lack of available capacity on the network to accommodate a development of this scale.

The location of each of these grid connection options are illustrated at **Annex 2.3** and further evaluated at **Table 2.3** below.

Design & Layout	Option G1	Option G2	Emerging Preferred Option
Factor			
Population & Human Health	Relatively low density of dwellings along the route of electricity line and vicinity of substation. Likelihood of temporary disruption to local residents during construction works.	Low density of dwellings in the vicinity of the substation and along the route of electricity line; however, the route would pass through a number of small settlements. Increased likelihood of temporary disruption to local residents during construction works compared to Option G1.	Option G1
Biodiversity	Identified route is generally not sensitive due to being predominately located within carriageway of public roads; however, the route crosses a number of lower order watercourses which discharge to the River Barrow and River Nore SAC & River Nore SPA.	Identified route is generally not sensitive due to being predominately located within carriageway of public roads; however, the route crosses the River Barrow and River Nore SAC and a number of lower order watercourses which discharge to the SAC.	Option G1
Land & Soil	The route is not generally sensitive.	The route is not generally sensitive.	Option G1 or Option G2
Water	The route would cross a number of watercourses each of which are hydrologically connected to the River Barrow & River Nore SAC. The substation is not located in close proximity to any important surface water feature.	The route would cross the River Barrow and a substantial number of other watercourses which form part of or are hydrologically connected to the River Barrow & River Nore SAC. The substation is not located in close proximity to any important surface water feature.	Option G1
Air & Climate	No constraints identified. Development would result in a positive overall effect.	No constraints identified. Development would result in a positive overall effect.	Option G1 or Option G2
Landscape	No protected landscape designations or designated scenic views in the	No protected landscape designations or designated scenic views in the	Option G1 or

	immediate vicinity. Substation location is substantially screened from public view.	immediate vicinity. Substation location is substantially screened from public view.	Option G2
Cultural Heritage	The electricity line route and substation are located in close proximity to a number of cultural heritage features but do not impinge on the footprint of any feature.	The electricity line route and substation are located in close proximity to a number of cultural heritage features (a greater number than Option G1) but do not impinge on the footprint of any feature.	Option G1
Noise & Vibration	Construction activities would take place in the immediate vicinity of dwellings along the route of the electricity line. Substation location is removed from dwellings and noise is unlikely to affect local residents.	Construction activities would take place in the immediate vicinity of a greater number of dwellings along the route in comparison to Option G1. Substation location is removed from dwellings and noise is unlikely to affect local residents.	Option G1
Shadow Flicker	Shadow Flicker cannot be generated.	Shadow Flicker cannot be generated.	N/A
Material Assets (Transport & Access; Telecommunications)	Short-term effects likely on transport & access during construction due to requirement for temporary road closures and diversions. No likelihood of significant effects on telecommunications.	Short-term effects likely on transport & access during construction due to requirement for temporary road closures and diversions. No likelihood of significant effects on telecommunications.	Option G1 or Option G2

Table 2.3: Environmental Assessment of Alternative Grid Connection Options

Following an assessment to determine the likelihood of environmental effects, it was concluded that neither Option G1 nor G2 were considered likely to give rise to significant effects. Option G1 is, however, considered to be preferential in environmental impact terms to Option G2 and was, therefore, selected as the preferred means of connecting the wind farm to the national electricity network.

2.4.6 Alternative Haul Routes

2.4.6.1 Turbine Components

It should be noted that there are a number of ports of entry for turbine components into Ireland and, therefore, an exact haul route cannot be confirmed until the completion of the turbine tendering process (i.e. prior to construction). The turbine manufacturer will ultimately determine the port of entry and, subsequently, the chosen haul route. However, given the relative proximity of Option L2 to the N78 (accessed from the M9 at Junction 3) and the subsequent access provided to the subject site by locally-classified sites; it can be confirmed that turbine components will travel along this route.

A number of ports may be used to import turbine components including Dublin Port, Port of Galway, Limerick-Shannon-Foynes Port, and the Port of Waterford. Turbine components travelling between any of the above-named ports and the M9/N78 junction will utilise national (including motorway) routes which are regularly used in the transportation of turbine components and will not require any particular upgrade works.

While each of the above-named ports have been assessed as feasible options; for the purposes of this EIAR, the Port of Waterford has been selected (for assessment purposes only) as the port of entry for turbine components. Therefore, a detailed haul route assessment, from the Port of Waterford to the site of Option L2 was undertaken and it was concluded that only minor works would be required to accommodate the delivery of wind turbine components. The necessary works are described in detail at **Chapter 3**.

2.4.6.2 Construction Materials

The construction phase of the project will require materials, such as stone aggregates and concrete, to be imported from selected suppliers. While substantial volumes of stone aggregates are likely to be encountered during excavations and utilised in the construction process, capping material for access tracks and crane hardstandings will be sourced from local quarries. No concrete batching will be undertaken at the project site and all concrete will be imported from local suppliers.

A range of potential local suppliers have, therefore, been considered and the potential haul routes to the main site entrance are illustrated at **Annex 2.4**. Potential suppliers include:-

- Dan Morrissey & Company, Clonmelsh Quarry, Carlow, Co. Carlow;
- Kilcarrig Quarries - Milford, Powerstown, Co. Carlow;
- Kilkenny Limestone, James Walshe Quarry, Oldleighlin, Co. Carlow;
- Kilcarrig Quarries, Kilcarrig, Bagenalstown, Co. Carlow;
- Kilkenny Limestone, Kellymount Quarry, Paulstown, Co. Kilkenny;
- Roadstone Bennettsbridge, Tinnaslatty, Bennettsbridge, Co. Kilkenny; and
- Bennettsbridge Limestone Quarries, Kilree, Sheastown, Co. Kilkenny.

The selection of construction material suppliers will be subject to a competitive tendering process prior to the commencement of development. Therefore, it is not currently possible to determine the precise material haul routes. While it is evaluated that there is no likelihood of significant effects on either the road network or third party access as a result of the movement of construction-related vehicles; in order to reduce any minor effects yet further, the chosen suppliers will be instructed to utilise motorway, national and regional roads, and avoid local roads, insofar as is possible and practicable. Thus, while the indicative haul routes presented at **Annex 2.4** do not necessarily represent the most direct route to the project site; they are deemed to be the most appropriate to ensure the protection of the road network in the region.

2.4.7 Alternative Forestry Replant Lands

While the majority of the infrastructure associated with Option D2 is located within pastoral grassland, some infrastructure is located within commercially afforested lands. Therefore, it is proposed to permanently remove 15 hectares (ha) of commercial forestry in order to accommodate the construction of turbine

foundations, access tracks, and other ancillary infrastructure; and to facilitate the physical operation of the wind turbines (see **Chapter 3** for further details).

All tree felling to be undertaken must be the subject of a felling licence application to the Forest Service in accordance with the Forestry Act 2014 and the Forestry Regulations 2017. In accordance with the Forest Service's published policy on granting felling licences for wind farm developments, areas of forestry which have been felled to accommodate wind turbines, turbine bases, access roads and any other wind farm-related uses must be replaced by replanting at an alternative site. The alternative site can be located anywhere within the Republic of Ireland.

As part of this process, the Developer identified 2 no. landbanks located within Co. Monaghan, each of which extend to an area of c. 15ha, which are considered to be generally suitable for afforestation, as follows:-

- **Option RP1:** Lands within the townland of Drumleek South and located c. 2.5km east of the town of Castleblayney; and
- **Option RP2:** Lands within the townland of Drumagelvin and located c. 3.5km northeast of the town of Castleblayney.

The location of each of these landbanks are illustrated at **Annex 2.5 (Volume II)** and further evaluated at **Table 2.4** below.

Design & Layout	Option RP1	Option RP2	Emerging Preferred Option
Factor			
Population & Human Health	Low density of dwellings in the vicinity generally comprising farmsteads. Potential for minor traffic disruption during planting operations.	Low density of dwellings in the vicinity generally comprising farmsteads; however, 2 no. dwellings immediately adjacent. Potential for minor traffic disruption during planting operations.	Option RP1
Biodiversity	Lands predominately comprise improved/semi-improved grassland; however, significant areas have become overgrown with gorse and scrub. Notwithstanding this, the site is not assessed to be of any particular ecological significance.	Lands largely comprise improved agricultural grassland bounded by mature hedgerows interspersed with trees. No particular ecological significance identified.	Option RP1 or Option RP2
Land & Soil	The identified lands are classed as having bedrock at or near the surface while localised areas of peat are also mapped.	The identified lands comprise sandstone and shale fill and are not geologically complex.	Option RP2
Water	There are no watercourses within or adjacent to the identified lands.	There are no watercourses within or adjacent to the identified lands.	Option RP1 or Option RP2

Air & Climate	No constraints identified.	No constraints identified.	Option RP1 or Option RP2
Landscape	A number of scenic viewpoints located to the southwest of the identified lands associated with Lough Muckno. Topography at this location is flat and forestry is unlikely to be particularly prominent in the landscape.	A number of scenic viewpoints located to the southwest of the identified lands associated with Lough Muckno; however, the identified lands are at a greater remove than those of RP1. Forestry at this location is unlikely to be particularly evident in the landscape.	Option RP2
Cultural Heritage	A heritage feature is present within the lands; however, it is stated to be 'redundant' and will not be included in future revisions of the Sites & Monuments Record.	A ringfort is located to the north of the identified lands.	Option RP1 or Option RP2
Noise & Vibration	Significant levels of noise or vibration are unlikely to be generated by works associated with re-planting activities.	Significant levels of noise or vibration are unlikely to be generated by works associated with re-planting activities.	Option RP1 or Option RP2
Shadow Flicker	Shadow Flicker will not be generated.	Shadow Flicker will not be generated.	N/A
Material Assets (Transport & Access; Telecommunications)	Short-term effects likely on transport & access during planting. No likelihood of effects on telecommunications.	Short-term effects likely on transport & access during planting. No likelihood of effects on telecommunications.	Option RP1 or Option RP2

Table 2.4: Environmental Assessment of Alternative Forestry Replant Lands

On the basis of the above, it is assessed that neither Option RP1 nor RP2 were considered likely to give rise to significant effects. Option RP2 is, however, considered to be preferential in environmental impact terms due to the habitats present and the increased separation from designated scenic viewpoints. Option RP2 was, therefore, selected and assessed for replanting with further details provided at **Chapter 3**.

2.5 Conclusion

This chapter has provided a description of the reasonable alternatives, which are relevant to the project and its specific characteristics, which have been assessed, evaluated and analysed, and an indication of the main reasons for selecting the preferred option, including a comparison of environmental effects. The 'Do-Nothing' Alternative; Alternative Technologies; Alternative Locations; Alternative Design & Layouts; Alternative Grid Connections; Alternative Haul Routes; and Alternative Forestry Replant Lands have all been discussed and analysed.

The objective of this process was to avoid any likely significant effects on the environment through the selection of a location for the project which avoided inherent environmental sensitivities, in favour of a location which had fewer constraints and greater capacity to sustainably assimilate the project. Once the preferred location was identified, a series of alternative designs and layouts were evaluated through a recursive, iterative design process, intended to resolve any likely significant environmental effects through an examination of localised constraints, including in the design and routing of off-site/secondary developments, which allowed the project designers to make informed decisions based on these constraints.

The final project assessed in this EIAR has therefore adopted the combination of design and layout options that strike the best balance between the avoidance of any likely significant environmental effects and achievement of the objectives of the project.

