Bracklyn Wind Farm

Chapter 2: Assessment of Project Alternatives

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Contents

2.1 Introduction

The presentation and consideration of the various reasonable project alternatives investigated is an important requirement of the EIAR 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 EIAR 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 EIAR to present transparent and objective evidence on the range of reasonable alternatives which were examined, analysed and evaluated as part of the iterative EIAR and project design decision-making processes, and which led to the adoption and selection of the final proposed development as described in **Chapter 3**.

The Draft *Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA, 2017)* 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.

Alternatives that are available for consideration at the earlier stages in the evolution of a project are considered to represent the greatest potential for avoidance of likely significant effects on the environment. The reasonable alternatives considered in undertaking this EIAR were therefore as follows:

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

Each of these alternatives were considered relevant to the proposed development 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 (a 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 recommits to a renewable energy target of at least 70% by 2030. According to the latest EPA projections, a 70% contribution of renewable energy in electricity generation by 2030 will mainly result from a further expansion in wind energy, including 8.2 GW of onshore wind as set out in the Climate Action Plan 2019. Increased renewables are projected to result in energy industries emissions decreasing by 24.8% over the period 2020 to 2030[1].

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 *Westmeath County Development Plan 2014-2020* and *Draft Westmeath County Development Plan 2021-2027* are both supportive of wind energy development at suitable locations within County Westmeath.

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

The quantum of renewable energy produced in County Westmeath 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 renewable energy sources, as outlined above, the 'Do Nothing' alternative was not considered a viable option.

It was further considered that there is significant potential within County Westmeath to deliver further wind energy generation capacity. At present, there is no installed commercial scale wind energy generating capacity in the county. There is only 50MW of permitted, but as yet un-built, capacity at Coole Wind Farm[2]. It is clear, therefore, that County Westmeath has very significant untapped potential to contribute to national targets.

[1] https://www.epa.ie/publications/monitoring--assessment/climate-change/air-emissions/EPA-Irelands-Greenhouse-Gas-Emissions-Projections-report_2020-2040.pdf

[2] The permitted Coole Wind Farm is currently subject to a judicial review and may, or may not, proceed. Other permitted or existing wind energy developments located within County Westmeath are small scale and do not appreciably contribute to the overall electricity generation within the county.

The 'Do-Nothing' option would result in a failure to capitalise upon and exploit the significant renewable wind energy resource available within County Westmeath, resulting in a lost opportunity to appreciably contribute to meeting national targets for the production of renewable electricity and the abatement of greenhouse gas emissions.

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 6MW wind turbine (and ancillary structures) is estimated to require a direct land-take of c. 1 hectares (2.5 acres) while a solar development with an output of 6MW would require a footprint area of c. 11 hectares (28 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.100 hectares thus substantially altering existing land-uses and agricultural practices.

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.

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.

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 objectives of 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 built heritage);
- Landscape and visual capacity;
- Accessibility;
- Energy and land-use planning policies; and
- Other Factors.

In assessing alternative locations, reference was made to the policies and objectives of the *Westmeath County Development Plan 2014-2020* and Draft *Westmeath County Development Plan 2021-2027*, 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.

The *Westmeath County Development Plan 2021-2027* does not include a standalone Wind Energy Strategy and guidance on specific locations for the development of wind energy. Overall, the entire county is deemed to be of 'Low Capacity' or 'No Capacity' for the delivery of wind energy developments. Therefore, given that no strategic areas for the provision of wind energy developments have been formally identified, a further assessment of possible reasonable alternative locations was undertaken. This assessment was based on the abovementioned criteria together with the general criteria included in the *Wind Energy Guidelines for Planning Authorities 2006*, the Draft *Revised Wind Energy Development Guidelines 2019* and the SEAI'S *Methodology for Local Authority Renewable Energy Strategies 2013*.

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

- **Option L1:** Mullingar, County Westmeath; and
- **Option L2:** Bracklin, County Westmeath.

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**.

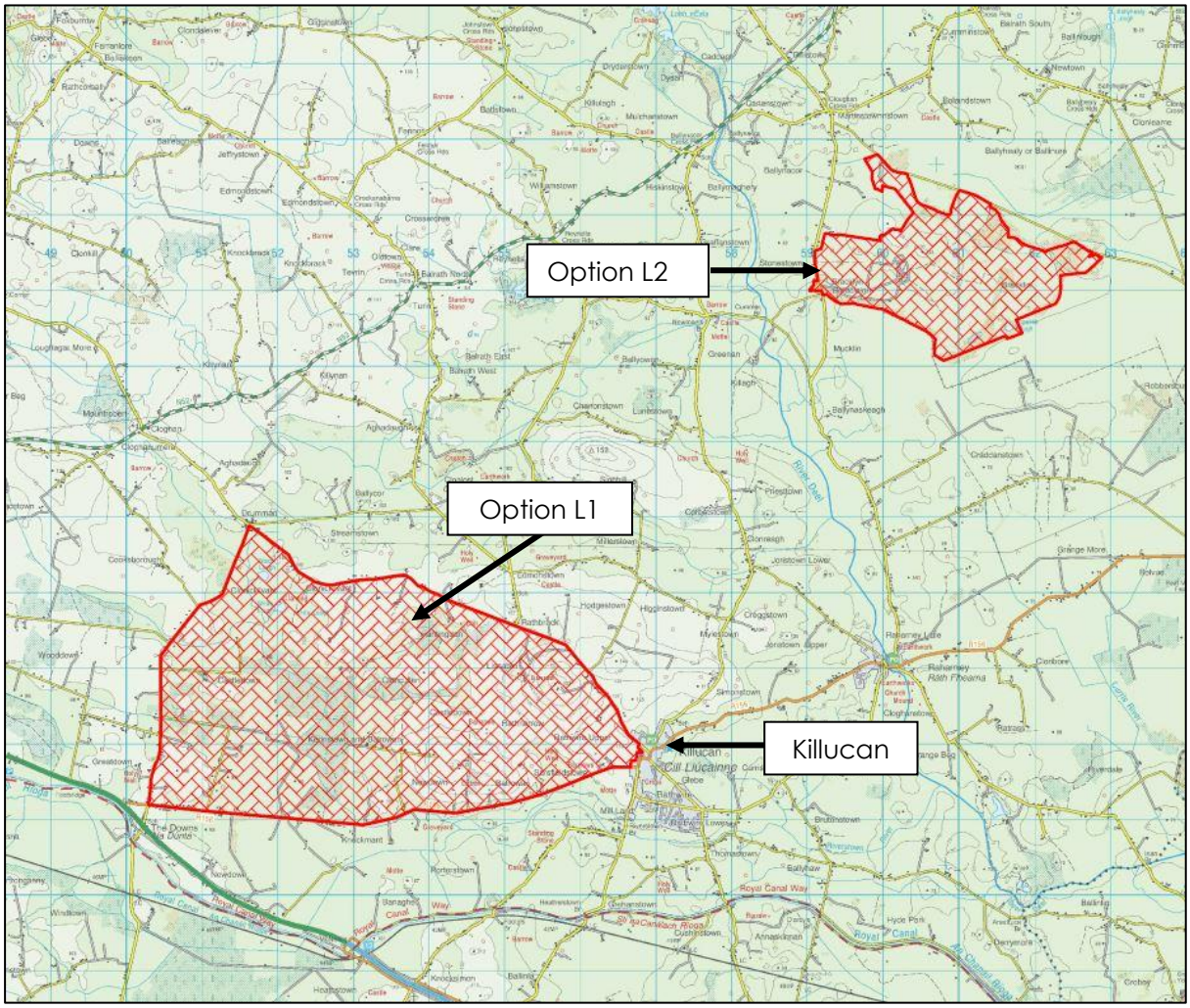

Figure 2.1: Alternative Locations

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 / Factor	Option L1	Option L2	Emerging Preferred Option
Population & Human Health	Low density of dwellings in vicinity of identified location. Approximately 2km to nearest urban settlement.	Low density of dwellings in vicinity of identified location. Approximately 3km to nearest urban settlement.	Option L2
Biodiversity	Identified site is generally not sensitive and primarily comprises intensively farmed pasture and commercial forestry plantation. The River Boyne & River Blackwater SAC are hydrologically connected	Identified site is generally not sensitive and primarily comprises intensively farmed pasture, fringed by some broadleaved woodland and commercial forestry plantation. The River Boyne &	Option L1 or Option L2

	and Wooddown Bog SAC and Mount Hevey Bog SAC are all located with 5km of the location.	River Blackwater SPA and SAC is located within 1km and the Bolandstown Stream, located within the identified site, provides a hydrological connection and potential pathway for effects.	
Land & Soil	Evidence of peat to the east of identified location but predominately underlain by limestone till and limestone sand and gravel.	Evidence of peat to the south and east of identified location.	Option L1 or Option L2
Water	Multiple lower order watercourses located within identified location. No major rivers in proximity.	A number of lower order watercourses identified within this location. No major watercourses present.	Option L1 or Option L2
Air & Climate	No constraints identified. Development would result in a positive overall impact.	No constraints identified. Development would result in a positive overall impact.	Option L1 or Option L2
Landscape	Identified location located within the Central Hills & Lakes Landscape Character Area which contains a number of designated High Amenity Areas; however, there are no protected landscape designations or designated scenic views in the immediate vicinity of this location.	Identified location located within the River Deel Lowlands landscape character area which does not contain any High Amenity Areas. Additionally, there are no designated scenic views or prospects in the wider vicinity of identified location.	Option L2
Cultural Heritage	Identified location contains a large number of heritage features.	Identified location is located within a historical demesne setting which contains a number of cultural heritage features.	Option L1
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.	Option L1 or 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.	Option L1 or Option L2
Material Assets (Transport & Access; Telecommunications)	No significant effects likely on transport. Location can be accessed via public road (national & regional routes) without the requirement for major upgrade works.	No significant effects likely on transport. Location can be accessed to within c. 2km via national roads with the final section via local roads which would require some upgrade works.	Option L1 or Option L2

	Existing telecommunication masts in wider vicinity of identified location but effects not likely to be significant.	Existing telecommunication masts in wider vicinity of identified location but effects not likely to be significant.	

Table 2.1: Environmental Assessment of Alternative Locations

Based on this analysis, it was determined that, although both locations were generally suitable, option Option L2, located at Bracklin, Co. Westmeath, 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 500 metres. These setback distances can be achieved at this location;
- 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 Boyne & River Blackwater SAC (Site Code: 002299) located c. 1km to the west. The nearest Special Protection Area (SPA) is the River Boyne & River Blackwater SPA (Site Code: 004232) located c. 1km to the west;
- The location is not the subject of any specific protective landscape designations under the provisions of the *Westmeath County Development Plan 2014-2020* or the *Draft Westmeath County Development Plan 2021-2027*;
- The location is well served by the national road network, with the N52 located c. 2km to the north of the identified location. 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 constraints in respect of aviation or telecommunications.

Importantly, from a technical and commercial viability perspective, Option L2 has an average wind speed of approximately 8.0m/s at c. 100m height which is sufficient to ensure the viability of a wind energy development. Option L2 is also in relative proximity to the Corduff-Mullingar 110kV overhead electricity transmission line which could accommodate electricity generated by a wind energy development, while the Delvin 38kV electricity substation is located c. 2km north of the identified location which provides a further potential point of connection to the national grid.

On this assessment basis, 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 proposed development 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 avoidance of likely significant environmental effects and 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 proposed development. 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;
- Setback from recorded archaeological sites; 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 also 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. 100m. 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 larger 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 103 MW. This wind energy complex has a large spatial extent and covers an area of c.1,135 hectares.

Having assessed the availability of land within Option L2, it was considered that the location could accommodate up to 22 no. wind turbines of up to 100m in height with

an electrical output of c. 35MW. However, a project with a smaller number (9-12 no.) of larger turbines of up to 185m in height could, on the other hand, generate up to c. 72MW 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:** 11 no. turbines with a maximum tip height of up to 170m (60 MW); and
- **Option D2:** 9 no. turbines with a maximum tip height of up to 185m (54 MW).

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 (11 Turbines, Maximum Height 170m, 60 MW)

Figure 2.3: Option D2 Site Layout (9 Turbines, Maximum Height 185m, 54 MW)

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 Factor	Option D1 (11 Turbines/170m)	Option D2 (9 Turbines/185m)	Emerging Preferred Option
Population & Human Health	Low number of dwellings in vicinity of turbines; no non-involved dwellings within 1km of a wind turbine. Adherence to the setback requirements of the Draft *Revised Wind Energy Development Guidelines 2019* is achievable.	Low number of dwellings in vicinity of turbines; no non-involved dwellings within 1km of a wind turbine. Adherence to the setback requirements of the Draft Revised *Wind Energy Development Guidelines 2019* is achievable.	Option D1 or D2

Biodiversity	Infrastructure to the east and south of the proposed development are located either within or in close proximity to broadleaved woodland and/or raised bog.	No likely significant effects identified. The project design generally avoids areas of broadleaved woodland and raised bog and is located in habitats of lesser importance.	Option D2
Land & Soil	Infrastructure to the east and south of proposed development are located either within or in close proximity to raised bog.	No likely significant effects identified. Some infrastructure may be located within mapped areas of localised/shallow peat; however, areas of raised bog have been avoided.	Option D2
Water	No likely significant effects identified. Some infrastructure located in close proximity to watercourses.	No likely significant effects identified and the level of infrastructure proximate to surface water features is reduced compared to Option D1.	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 due to reduced number of turbines and reduced likelihood of visual clutter.	Option D2
Cultural Heritage	The site is located in a demesne setting, albeit its sensitivity has been significantly diminished, and contains a number of heritage features. The development does not impinge on the footprint of any feature but visual effects on the features are likely due to relative proximity.	The site is located in a demesne setting, albeit its sensitivity has been significantly diminished, and contains a number of heritage features. The development does not impinge on the footprint of any feature but visual effects on the features are likely due to relative proximity. The reduced number of turbines, despite a modest increase in tip height, is likely to reduce significant visual effects.	Option D2
Noise & Vibration	No likely significant effects identified due to the substantial setbacks (720m) from the nearest dwelling.	No likely significant effects identified due to the substantial setbacks (720m) from the nearest dwelling.	Option D1 or Option D2

Shadow Flicker	No likely significant effects identified due to the substantial setbacks (720m) from the nearest dwelling.	No likely significant effects identified due to the substantial setbacks (720m) from the nearest dwelling.	Option D1 or Option D2
Material Assets (Transport & Access; Telecommunications)	No likely significant effects identified on transport. Site can be accessed via public road (national & local routes) but will require some upgrades to junctions and carriageways. No likely significant effects on telecommunications have been identified by any service provider through the consultation process.	No likely significant effects identified on transport. Site can be accessed via public road (national & local routes) but will require some upgrades to junctions and carriageways. No likely significant effects on telecommunications have been identified by any service provider through the consultation process. The reduced number of turbines will serve to reduce the likelihood of adverse effects on local television or radio signals.	Option D2

Table 2.2: Environmental Assessment of Alternative Site Designs and Layouts

Based on this appraisal, it was concluded that Option D2 (9 no. turbines) was the emerging preferred project design and layout for the following reasons:-

- A similar 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, Land & Soil, Landscape and Cultural Heritage;
- Option D2 provides for the general avoidance of important habitats including broadleaved woodland and raised bog;
- Option D2 avoids areas of raised bog thus reducing the likelihood of effects on sensitive geology;
- The reduction in turbine numbers, and consequently ancillary infrastructure, minimises the interaction between construction activities and surface water features. In particular, the extent of construction in the immediate vicinity of watercourses and the number of watercourse crossings have been reduced;
- A reduced number of turbines will minimise any likelihood of significant 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 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 potential for 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 for 'Hilly and Flat Farmland' landscape character types;
- Option D2 provides for greater avoidance of features of cultural or heritage significance and the reduced turbine numbers will limit the level of visual effects; and
- A consolidated project of 9 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 site (Option L2) contained a number of important species and habitats; while others raised concerns regarding visual impact. 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:-

- Vestas V162-6.0;
- Vestas V162-5.6;
- General Electric GE 5.6-158; and
- Siemens Gamesa SG 5.8-155.

Each of these turbine models were deemed to be generally suitable for installation at the subject site and, subject to planning permission being granted, could be considered in the competitive tender process prior to the commencement of development. However, based on the analysis undertaken, the Vestas V162-6.0 was considered to be the most suitable for the site and was selected as the turbine model for the proposed development (see **Chapter 3** for further details).

2.4.4.1 Subsequent Design Modifications

The selection of alternative location Option L2 and alternative design and layout Option D2 formed the basis of the proposed development. However, the project team maintained a flexible view of the project design and layout to ensure that if further environmental constraints were identified during fieldwork, or if modifications were deemed necessary as a result of updated or revised guidance, the layout could be further revised. This flexible view was maintained through the survey work undertaken to inform the preparation of the EIAR and the EIAR preparation itself.

As a consequence of the above, the proposed development (as presented in the planning application) does not precisely mirror Option D2, as selected above, and was subject to a substantial number of further design revisions during the EIAR preparation process including *inter alia*:-

- Careful consideration of the presence of hedgerow/treeline vegetation and adjustments to ancillary infrastructure; including access tracks, crane hardstandings, underground electricity cables; to minimise the extent of vegetation removal;
- Assessment of landscaping and environmental/ecological enhancement opportunities and consequential re-siting of ancillary infrastructure to maximise opportunities to maintain ecological connectivity within the site;

- Comprehensive assessment of forestry habitats at T4, T5, T6, T7, T10 and T11 to minimise the requirement to fell natural/broadleaved woodland;
- The selection of spoil deposition areas following environmental assessment of a number of possible locations; and
- The proposed construction of a site control building to the west of T10 and careful consideration of constraints to ensure its appropriate siting.

Each of the above modifications brought about the revision of the proposed infrastructure or the introduction of new infrastructure and the final proposed layout, as presented in the planning application, was the outcome of a recursive process of 'design–assess-redesign'. The proposed development is, therefore, the culmination of an extensive iterative 'mitigation by design' process which, inherent to the project design, has sought to resolve any likely significant environmental effects through an examination of localised constraints and assessment of all reasonable alternatives.

2.4.5 Alternative Grid Connections

The method of connection to the national electricity grid is also an integral element of the overall proposed development 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 Applicant, 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 the nearby existing 110kV electricity transmission network is the most likely method of connection.

As discussed above, the Corduff-Mullingar 110kV overhead electricity transmission line passes c. 3km south of Option L2 and is, therefore, the most suitable means of connecting to the electricity transmission network. As there are no existing electricity substations located along this part of the Corduff-Mullingar overhead line, it is considered that the most suitable and appropriate means of connecting to the electricity line is through the construction of a new 110kV electricity substation.

Following this determination, an extensive technical and environmental feasibility assessment was completed to identify suitable locations for the development of an electrical substation and for the installation of grid connection infrastructure. As a result of this analysis, 2 no. electrical substation and grid connection options were identified as being generally viable alternatives, as follows:-

- **Option G1:** Construction of a 110kV substation in the townland of Joristown Lower, Co. Westmeath and installation of underground electricity line along public roads and within private lands between Option D2 and the identified substation location; and
- **Option G2:** Construction of a 110kV substation within the site of alternative layout Option D2, in the townland of Bracklin, Co. Westmeath and installation of underground electricity line along public roads and within private lands between this substation and the existing Corduff-Mullingar 110kV overhead electricity transmission line in the townland of Coolronan, Co. Meath.

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 Factor	Option G1	Option G2	Emerging Preferred Option
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 proposed substation and along the route of electricity line. Likelihood of temporary disruption to local residents during construction works; but level of disruption is reduced compared to Option G1.	Option G2
Biodiversity	Identified electricity line route is generally not sensitive due to being predominately located within carriageway of public roads; however, the crossing of the River Deel and River Boyne & River Blackwater SAC & SPA would be required. Substation location is partially within the River Boyne & River Blackwater SAC.	Substation site located within an area of commercial forestry and is of lower ecological importance. Electricity line route is generally not sensitive due to being partially located within carriageway of public roads; while off-road sections are typically within improved/ semi-improved grassland. The route would require the crossing of the Bolandstown stream thus giving rise to the potential for downstream effects on the River Boyne & River Blackwater SAC.	Option G2
Land & Soil	The electricity line route is not generally sensitive but may pass through localised areas of peat. The substation location is underlain by peat.	The electricity line route is predominately located within areas of mapped peat. The substation location, which will contribute the majority of excavation works and interaction with soil, is mapped as being underlain by peat.	Option G1
Water	The electricity cable route would cross 4 no. watercourses (including the River Deel), each of which are hydrologically connected to the River Boyne & River Blackwater SAC. The substation is located in close proximity to the River Deel and may be at risk of flooding.	The electricity cable route would cross 2 no. watercourses which are hydrologically connected to the River Boyne & River Blackwater SAC. The electricity line route also passes through mapped areas at risk of flooding. The substation is not evaluated as being at risk of flooding.	Option G2

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 immediate vicinity. Substation location is remote and substantially screened from public view.	No protected landscape designations or designated scenic views in the immediate vicinity. Substation location is located within an enclosed setting and not readily visible from any public location.	Option G1 or 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 not located within close proximity to cultural heritage features. There are no features within 200m of proposed infrastructure.	Option G2
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 fewer dwellings along the route in comparison to Option G1. Substation location is removed from dwellings and noise is unlikely to affect local residents.	Option G2
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 2.2: Environmental Assessment of Alternative Grid Connection Options

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

2.4.5.1 Alternative Substation Design Technologies

Following the determination that Option G2 represents the preferred grid connection option, the Applicant undertook an analysis of technological design options, including internal electrical equipment and plant, which could be provided for as part of the proposed substation. Depending on the alternative design technologies deployed,

there will be minor variations in terms of internal substation layout and footprint. The consideration of alternative design technologies was therefore an important consideration in the context of the generally fixed location for the substation in the context of the specific characteristics and topography of the proposed development site.

It is important to note that the design of such substations must accord with EirGrid specifications and, as such, the scope for installing alternative electrical apparatus and design technologies is very limited. Within EirGrid specifications for 110kV substations, there are currently two approved designs (see **Annex 2.4**), as follows.

Option SD1: 'Air-Insulated Switchgear' Substation

Air-Insulated switchgear (AIS) substations are conventional switchgear substations which use air as phase-to-ground and phase-to-phase insulation. Air is the primary medium for insulation within these systems. AIS units have been extensively used in the last few decades. Within AIS substations, electrical equipment is located outdoors and is spaced at a sufficient distance from ground and from other equipment to maintain safe electrical and maintenance clearances.

Option SD2: 'Gas-Insulated Switchgear' Substation

Gas-insulated switchgear (GIS) substations comprise standard electrical equipment which includes circuit breakers, current transformers, voltage transformers, disconnect and ground switches, interconnecting busbars, surge arresters, and connections to the electricity grid. GIS enclosures are typically cast or welded aluminium. GIS enclosures are pressure sealed and designed to remain closed throughout the lifetime of the equipment, which is typically 50 years or more. A GIS substation uses Sulphur Hexafluoride (SF6) at a moderate pressure for phase-to-phase and phase-to-ground insulation. SF6 has 2-3 times greater insulating ability of atmospheric air at the same pressure which results in a more compact overall substation size. The high-voltage conductors, circuit breaker interrupters, switches, current transformers, and voltage transformers are encapsulated in SF6 gas inside grounded metal enclosures.

Assessment of Alternative Substation Design Options

A comprehensive technical and environmental evaluation of Options SD1 and SD2 was undertaken by the Applicant to determine which option represented the most suitable and appropriate alternative for the proposed development. It was concluded that both options were feasible from a technical standpoint and that neither option was likely to result in significant environmental effects.

GIS substations are, on occasion, developed as part of renewable energy developments and have a slightly smaller footprint. AIS substations are, however, generally considered to be the most appropriate technology for renewable energy projects as it allows for greater flexibility in terms of any future development of the substation which EirGrid may decide to undertake.

Therefore, given that both options were technically feasible and that neither option was evaluated as likely to result in significant environmental effects, it was considered that the development of an AIS substation (Option SD1) was preferable due to the greater flexibility afforded by this design. The increased range of options for future development afforded by an AIS substation was considered to outweigh any minor reduction in environmental effects (e.g. slightly reduced level of groundworks etc.) which would arise from the development of a GIS substation.

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 proximity of Option L2 (and Option D2) to the N52 and the subsequent access provided to the subject site by the L1504 and L5508; it can be confirmed that turbine components will travel, from the M4/N52 junction at Mullingar, along this route.

A number of ports may be used to import turbine components including Dublin Port, Port of Galway, Port of Limerick, Shannon-Foynes Port, and the Port of Waterford. Turbine components travelling between any of the above-named ports and the M4/N52 junction will utilise a combination of regional and national (including motorway) routes which are regularly used in the transportation of turbine components and will not require extensive upgrade works.

While each of the above-named ports are 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 (Option D2) was undertaken and it was concluded that only minor works, of a temporary nature, would be required to accommodate the delivery of wind turbine components between the port of entry and the N52.

2.4.6.2 Construction Materials

The construction phase of the proposed development will require materials, such as stone aggregates and concrete, to be imported from chosen suppliers as the proposed development will not include any on-site borrow pits or concrete batching. A range of potential local suppliers have therefore been considered and the potential haul routes to the main site entrance are illustrated at **Annex 2.5**. Potential suppliers include:-

- Keegan Quarries, Rathmoylon, Co. Meath;
- Lagan (Breedon) Cement, Kinnegad, Co. Westmeath;
- Owens Quarry Products, Knockdrin, Co. Westmeath;
- P. Plunkett Limited, Finea, Mullingar, Co. Westmeath;
- B.D. Flood, Murrens, Oldcastle, Co. Meath; and
- J.J. Flood, Murrens, Oldcastle, Co. Meath.

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 regional roads, and avoid local roads, insofar as is practicable. Thus, while the indicative haul routes presented above and at **Annex 2.5** do not necessarily represent the most direct route to the proposed development site; they are deemed to be the most appropriate to ensure the protection of the road network in the region.

2.5 Conclusion

This chapter has provided a description of the reasonable alternatives, which are relevant to the proposed development 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; and Alternative Haul Routes for turbine components and construction materials have all been discussed and analysed.

The objective of this process was to avoid any likely significant effect on the environment through the selection of a location for the proposed development which avoided inherent environmental sensitivities, in favour of a location which had fewer constraints and greater capacity to sustainably assimilate the proposed development. 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 proposed development evaluated 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.