FEHILY TIMONEY

DESIGNING AND DELIVERING A SUSTAINABLE FUTURE

ENVIRONMENTAL IMPACT ASSESSMENT REPORT (EIAR) FOR THE PROPOSED LITTLETON WIND FARM, CO. TIPPERARY

Volume 2 - Main EIAR

Chapter 3 - Consideration of Reasonable Alternatives

Prepared for:
Littleton Wind Farm DAC

BnM | sse

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3. CONSIDERATION OF REASONABLE ALTERNATIVES

3.1 Introduction

This chapter, in accordance with EU guidance document*: 'Guidance on the preparation of the Environmental Effect Assessment Report'* (EU Commission, 2017), sets out the reasonable alternatives which were considered by the Applicant for the Proposed Development. It provides a summary of the rationale for selecting the chosen design/layout having considered the site constraints and potential environmental effects. Furthermore, it describes the Site selection process, alternative design philosophies considered, alternative layouts and the do-nothing alternative.

The Proposed Development as described in Chapter 4 - Development Description comprises the following elements:

- The 'Proposed Wind Farm' (also referred to in this EIAR as the '**Site'**);
- The 'Proposed Grid Connection' (also referred to in this EIAR as the **'GC'**);
- The 'Turbine Delivery Route' (also referred to in this EIAR as the **'TDR'**);
- The 'Biodiversity Enhancement and Management Plan Lands' (also referred to in this EIAR as the **'BEMP Lands'**);

The location of the Proposed Development is shown in Figure 4.1, contained within Volume 4 of the EIAR. The general layouts of the Proposed Wind Farm, Grid Connection (GC) route and Turbine Delivery Route (TDR) are presented in Figures 4.2 to 4.4, Volume 4.

3.2 Statement of Authority

This chapter was prepared by Evan Rossiter of Fehily Timoney and Company.

Evan is a Senior Project Planner with a BSc in City Planning and Environmental Policy and a Masters in Regional and Urban Planning (MRUP) from University College Dublin. Evan has 3 years' experience and has prepared EIAR Chapters for a range of development types, including renewable energy developments, throughout Ireland.

Thie chapter has been reviewed by Conor Auld and Jim Hughes.

Conor Auld is a Principal Planner with over 10 years' experience in professional planning practice. Conor holds a MSc in Urban and Rural Design and BSc in Environmental Planning from Queen's University Belfast. Conor also holds an advanced Diploma in Planning and Environmental Law from The Honourable Society of King's Inns. Conor has prepared several EIAR Chapters and assisted in EIAR management for wind farm developments throughout Ireland.

Jim Hughes holds a BA in Public Administration from the University of Limerick, an MSc in Town Planning from Queen's University Belfast and a Higher Diploma (H.Dip) in Environmental Impact Assessment from University College Dublin and has over 20 years of experience. Jim has led major Irish projects in the planning, environmental assessment and permitting disciplines including many wind farm developments.

3.3 Alternative Assessment

The requirement in relation to alternatives in the EIA process is set out in the *European Union Directive 2011/92/EU, as amended by Directive 2014/52/EU on assessment of the effects of certain public and private Projects on the environment* (the "EIA Directive"). Article 5 (1)(d) states that an EIAR should include:

> *"a description of the reasonable alternatives studied by the developer, which are relevant to the project and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the project on the environment".*

Article 5(1)(f) of the EIA Directive requires that the EIAR contains

> *"any additional information specified in Annex IV relevant to the specific characteristics of a particular project or type of project and to the environmental features likely to be affected"*

Annex IV of the EIA Directive states that the information provided in an EIAR should 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 the environmental effects."*

This chapter has particular regard to the environmental considerations which influenced the selection of alternatives and details the evolution of the Proposed Development through alternatives considered, indicating the main reasons for selecting the chosen option taking into account the effects on the receiving environment and considering the comparison of environmental effects of each alternative.

The alternatives considered have been described in line with the *Guidelines on the Information to be Contained in Environmental Effect Assessment Reports* (EPA, 2022). The Guidelines state:

> *"It is generally sufficient to provide a broad description of each main alternative and the key issues associated with each, showing how environmental considerations were taken into account in deciding on the selected option. A detailed assessment (or 'mini-EIA') of each alternative is not required."*

This Chapter also details non-environmental factors of the design process where they are relevant to the evolution of the Proposed Development.

Consequently, taking account of the legislation and guidance requirements, this chapter of the EIAR addresses alternatives under the following headings:

- 'Do Nothing' Alternative;
- Alternative Locations (the Strategic Site Selection process);
- Alternative Renewable Energy Technologies;
- Alternative Layouts (including alternative turbine numbers);
- Alternative Design (including transport routes, site access, and grid connection routes);
- Alternative Processes;
- Alternative Operational Life.

3.3.1 Do-Nothing Alternative

Article IV, Part 3 of the EIA Directive states that the EIAR should include *"a description of the relevant aspects of the current state of the environment (baseline scenario) and an outline of the likely evolution thereof without implementation of the project as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge"*. This is referred to as the *"do nothing"* alternative.

Through its commitments under CAP 24 and CAP 25, Ireland is obliged to ensure that 80% of the total energy consumed in heating, electricity and transport is generated from renewable resources by 2030. This is in order to help reduce the nation's CO2 emissions and to promote the use of indigenous renewable sources of energy. These targets have been incorporated into national policy, most recently within the latest Climate Action Plans (2024 & 2025). Of note is the European Commission Guidance (EU, 2017)[1] which acknowledges that the do-nothing scenario may not be a reasonable alternative where there is a pressing need for the project supported by policy.

Under the "Do-Nothing" scenario, the Proposed Development would not proceed i.e. the development of a renewable energy project is not pursued, and the Site remains in its current form as bogland and agricultural land.

Please note that irrespective of the consenting of the Proposed Wind Farm the remaining measures outlined in the Rehabilitation Plans, i.e. monitoring of the Littleton, Longfordpass and Lanespark Phase 1 measures and enhanced Phase 2 measures at nearby Ballybeg and Derryvella bogs, will continue to be implemented by BnM in agreement with the EPA. Please see Appendix 2.1 (Volume 3 of the EIAR) and Section 2.2.1 of Chapter 2 of the EIAR for further detail.

Irrespective of whether the Proposed Development proceeds or not, the peatlands within the site will continue to accumulate CO_2, as the Proposed Wind Farm will not interfere with the rehabilitation or compromise re-wetting and revegetation or regeneration at the site scale.

If the Proposed Development does not proceed, up to 9,585 tonnes of additional CO_2 could be accumulated by bog plants locally under the footprint of land lost due to the Wind Farm construction and the areas affected by drainage. This represents only 0.3% of the carbon emission saved (fossil fuel - mix electricity generation) over the 35-year lifetime (see Chapter 10 for further details).

[1] European Commission (2017), Guidance on the preparation of the environmental impact assessment report (Directive 2011/92/EU as amended by 2014/52/EU)

While re-wetting peatlands is proven to be a viable solution to reducing land-use carbon emissions, this only gets significant when considering re-wetting and land-use carbon emission reductions across large land areas and over long periods. The calculations provided indicate that wind energy is ultimately much more effective at reducing carbon emissions over the relatively short lifetime of the wind farm, when compared to re-wetting peatlands across equivalent areas and equivalent time periods on a like-by-like basis. Integrating this wind energy development, which will take up only a small footprint, within this much larger rehabilitated peatland site improves the overall carbon emissions reductions associated with the Site.

In the "Do-Nothing" scenario, the prospect of creating sustainable energy through Tipperary's wind energy resources would be lost at this location. The nation's ability to produce sustainable energy and reduce greenhouse gas emissions to meet EU targets and National Targets, as set out above, would be stifled. This may contribute to Ireland incurring significant financial penalties from the EU if targets are not achieved and result in continued global warming. Additionally, it would affect Ireland's commitment to "pursue efforts" to limit warming as agreed to in the Paris Agreement (2015). This will result in continued likely significant negative effects to air quality and climate.

According to EirGrid's 'Generation Capacity Statement 2023 - 2032' (EirGrid, January 2024), the energy demand in Ireland is forecasted to increase 43% by 2032 (median scenario). This is a marked increase on previously predicted forecasts with the 2020 - 2029 Generation Capacity Statement predicting only 33% (median scenario) increase in demand. Much of this revised forecasting is attributable to the predicted demand by data centres, with the CSO statistical publication of ‘Data Centres Metered Electricity Consumption’ (23 July 2024) noting that energy demand by data centres increased by 20% between 2022 and 2023. EirGrid’s publication predicts that 30% of all electricity demand is expected to come from data centres by 2032.

Under the "Do-Nothing" scenario, the socio-economic benefits associated with the Proposed Development will be lost. These benefits include approximately 80 - 100 no. jobs during the construction period and 2-3 no. jobs during operation and maintenance phases of the Proposed Development (and a similar number to construction during decommissioning). Please refer to Chapter 4 - Description of the Proposed Development which sets out in Section 4.8 the full extent of the Community Benefit to be provided, should the scheme go ahead. Additionally, as described in Section 4.4.1 of Chapter 4 -Development Description, as part of the Proposed Development, a recreational amenity in the form of walking and cycling trails is proposed within the Wind Farm Site to enhance public access and promote the recreational use of the area and tie in with the existing Littleton Labyrinth; an existing amenity route developed by Tipperary County Council which provides a shared walking and cycling route connecting the village of Horse and Jockey to Lough Derryvilla. Under the "Do-Nothing" scenario, the socio-economic benefits associated with the proposed recreational amenity will be lost.

Furthermore, under the "Do-Nothing" scenario the local community will not benefit economically from the community benefit fund associated with the Proposed Development which could be used to improve physical and social infrastructure in the locality.

In the "Do-Nothing" scenario, the potential environmental effects of the Proposed Development as set out throughout this EIAR will not occur. Table 3-1, below sets out the potential effects of the 'do-nothing scenario' compared to the residual effects associated with the Littleton Wind Farm in relation to the various environmental topics covered in the individual chapters of this EIAR.

Refer to each respective chapter for full details of residual effects.

Table 3-1: Comparison of Potential Residual Environmental Effects - Proposed Development vs. 'Do-nothing'

Environmental Consideration	Residual Effect of the Proposed Development	'Do-nothing' Alternative
Air Quality & Climate	Slight to moderate temporary localised residual effects arising from fugitive dust emissions during construction. Long-term positive effect on climate due to reduction in burning of fossil fuels. It is estimated that an annual average output of 68.2 MW for the Proposed Development will result in the net displacement of 2,787,319 tonnes of CO2 over the proposed 35-year lifetime of the wind farm, equating to approximately 79,638 tonnes of CO2 per annum (please refer to Chapter 10 - Air Quality and Climate).	Fossil fuel power stations will likely be the primary alternative to provide the required quantities of electricity resulting in greenhouse gas and other air pollutant emissions. Irrespective of whether the Proposed Development proceeds or not, the peatlands within the site will continue to accumulate CO2, as the Proposed Wind Farm will not interfere with the rehabilitation or compromise re-wetting and revegetation or regeneration at the site scale. If the Proposed Development does not proceed, up to 9,585 tonnes of additional CO2 could be accumulated by bog plants locally under the footprint of land lost due to the Wind Farm construction and the areas affected by drainage. This represents only 0.3% of the carbon emission saved (fossil fuel - mix electricity generation) over the 35-year lifetime (see Chapter 10 for further details). While re-wetting peatlands is proven to be a viable solution to reducing land-use carbon emissions, this only gets significant when considering re-wetting and land-use carbon emission reductions across large land areas and over long periods. The calculations provided indicate that wind energy is ultimately much more effective at reducing carbon emissions over the relatively short lifetime of the wind farm, when compared to re-wetting peatlands across equivalent areas and equivalent time periods on a like-by-like basis. Integrating this wind energy development, which will take up only a small footprint, within this much larger rehabilitated peatland site improves the overall carbon emissions reductions associated with the Site.

Environmental Consideration	Residual Effect of the Proposed Development	'Do-nothing' Alternative
Noise & Vibration	While the operational wind farm noise levels meet the daytime and night-time noise limits derived using the Wind Energy Development Guidelines 2006, for some receptors a new source of noise may be introduced into the local soundscape. As such the Proposed Development would pose a long term long term slight to moderate effect for dwellings within the 35 dB LA90 study area with a moderate effect on the closest dwellings to the Proposed Wind Farm. (refer to Chapter 11 – Noise and Vibration). In conclusion, as established in Chapter 11 – Noise and Vibration, there are no significant effects arising from the Proposed Development.	Under the do-nothing scenario, the Proposed Development is not constructed or operated. It is expected that the existing land uses at the site will continue in the absence of the Proposed Development, with prevailing noise levels remaining unchanged. Please note that irrespective of the consenting of the Proposed Wind Farm the remaining measures outlined in the Rehabilitation Plans, i.e. monitoring of the Littleton, Longfordpass and Lanespark Phase 1 measures and enhanced Phase 2 measures at nearby Ballybeg and Derryvella bogs, will continue to be implemented by BnM in agreement with the EPA. Please see Appendix 2.1 (Volume 3 of the EIAR) and Section 2.2.1 of Chapter 2 of the EIAR for further detail.
Biodiversity	The construction of the wind farm will not result in significant effects for any national or European designated sites, subject to the implementation of mitigation measures. Whilst no significant residual effects are predicted for the Habitats and Flora, the Proposed Development will lead to some permanent habitat loss, with the BEMP lands including for an overall uplift in biodiversity in the area. Effects on mammals, including bats, are not significant given the open nature of the Site. The interaction between the Proposed Development and the aquatic environment is limited to watercourse crossings and will not result in significant effects.	Under the Do-Nothing scenario the existing agricultural, forestry and turbary practices at the site will continue. Please note that irrespective of the consenting of the Proposed Wind Farm the remaining measures outlined in the Rehabilitation Plans, i.e. monitoring of the Littleton, Longfordpass and Lanespark Phase 1 measures and enhanced Phase 2 measures at nearby Ballybeg and Derryvella bogs, will continue to be implemented by BnM in agreement with the EPA. Please see Appendix 2.1 (Volume 3 of the EIAR) and Section 2.2.1 of Chapter 2 of the EIAR for further detail. The opportunity to improve biodiversity through Enhancement measures outlined in the BEMP will be lost however.

Environmental Consideration	Residual Effect of the Proposed Development	'Do-nothing' Alternative
	In conclusion, as detailed in Chapter 6 - Biodiversity, with the implementation of the detailed mitigation measures (outlined in the Natura Impact Statement, Chapter 6 - Biodiversity, Chapter 8 - Land, Soils and Geology and Chapter 9 - Hydrology, Hydrogeology and Water Quality and the CEMP) there will be no significant residual impacts from the Proposed Development on biodiversity.	
Ornithology	During the construction stage, direct habitat loss is limited and focused on lower-value habitats such as cutover bog and agricultural grassland. The total habitat loss is small relative to the site area. Indirect effects include disturbance and displacement due to noise, vibration, and visual intrusion, potentially causing birds to vacate territories near construction. Collision risk is the main direct effect during operation, with species-specific susceptibility influenced by flight behavior and morphology. No significant effects were identified for any key receptor species.	Neutral from an ornithology perspective, as existing flight patterns and flight lines will remain Please note that irrespective of the consenting of the Proposed Wind Farm the remaining measures outlined in the Rehabilitation Plans, i.e. monitoring of the Littleton, Longfordpass and Lanespark Phase 1 measures and enhanced Phase 2 measures at nearby Ballybeg and Derryvella bogs, will continue to be implemented by BnM in agreement with the EPA. Please see Appendix 2.1 (Volume 3 of the EIAR) and Section 2.2.1 of Chapter 2 of the EIAR for further detail.
Land, Soils, Geology	Following the implementation of mitigation measures, the residual impact on the receiving environment is imperceptible during the construction period and imperceptible during the operation of the Proposed Development. In conclusion, as established in Chapter 8 – Land, Soils and Geology, there are no significant effects arising from the Proposed Development.	In the Do-Nothing scenario, it is likely that the current land uses will continue for the foreseeable future. The effect on the Land, Soils and Geology would remain largely unaltered as a result.

Environmental Consideration	Residual Effect of the Proposed Development	'Do-nothing' Alternative
Hydrology & Water Quality	Potential effects on hydrology and water quality will be mitigated through the design of the Proposed Development. In relation to the construction phase of the Proposed Development, these measures are detailed in Chapter 9. Through the implementation of these measures, the residual impacts of the construction stage are not significant. Regarding the operational phase of the Proposed Development, potential impacts were determined to be non-significant. Following the implementation of precautionary measures such as visual monitoring and water quality monitoring, the residual risk is maintained as non-significant. Lastly, following the implementation of mitigation measures, the residual impacts associated with the decommissioning phase of the Proposed Development are deemed to be a non-significant likely effect. In conclusion, as established in Chapter 9 - Hydrology, Hydrogeology and Water Quality, there are no significant effects arising from the Proposed Development	If the Proposed Development was to not proceed, it is anticipated that programmes of measures under the Water Framework Directive will result in maintenance or will result in gradual improvement in catchment quality. Furthermore, the opportunity to improve habitat through the inclusion of Riparian Protection Zones and improve water quality with wetland drains and silt traps would be lost. (Please refer to the BEMP contained in Appendix 6.1).
Population & Human Health	A long-term slight positive effect will occur with respect to Population and Human Health due to the creation of job opportunities and the community benefit fund as well as the proposed recreational amenity in the form of walking and cycling trails is proposed within the Wind Farm Site to enhance public access and promote the recreational use of the area and tie in with the existing Littleton Labyrinth.	No economic benefit for the local area due to no provision of a community benefit fund. No employment opportunities as a result of the construction, operation and decommissioning of the Proposed Development. Opportunity lost to help achieve the States renewable electricity targets which could have an indirect impact on climate change and consequently health. Additionally, the socio-economic benefits associated with not developing the proposed recreational amenity and enhancement of the Littleton Labyrinth will be lost.

Environmental Consideration	Residual Effect of the Proposed Development	'Do-nothing' Alternative
	Other positive residual effects include, inter alia, the provision of lean renewable electricity which would otherwise be emitted through the burning of fossil fuels; capital investment in the area through the community benefit fund and the potential upgrading of the amenities in the area. Please refer to EIAR Chapter 5 - Population and Human Health for more details. In conclusion, as established in Chapter 5 - Population and Human Health, there are no significant effects arising from the Proposed Development.	
Material Assets	Long-term slight positive residual effect on non-renewable resources by offsetting the use of fossil fuels in electricity generation. Slight positive residual effect on electricity infrastructure in the area of the wind farm site. Slight negative effect to capacity of licensed waste facilities. The construction of the Proposed Development will lead to additional construction traffic and vehicular movements, including HGV's, along existing roadways during the construction phase. As outlined in EIAR Chapter 15 - Material Assets following the implementation of mitigation measures this will have a slight, negative, temporary to short term impact on the local road network. In conclusion, as established in Chapter 15 - Material Assets which includes the Traffic EIA assessment, there are no significant effects arising from the Proposed Development. No significant residual effects are expected on telecommunications and broadcasting and aviation as a result of the proposed Littleton Wind Farm.	No offset to fossil fuel use. No provision of additional electricity infrastructure in the local area. No slight negative effect to capacity of licensed waste facilities. If the Proposed Development is not constructed, existing traffic patterns will likely remain. If the Proposed Development were not to proceed, there would be no change to the existing telecommunications, broadcasting and aviation operations in the area.

Environmental Consideration	Residual Effect of the Proposed Development	'Do-nothing' Alternative
Archaeology & Cultural Heritage	Mitigation measures will provide for either the avoidance of potential unrecorded, sub-surface archaeological resource within the footprint of Proposed Development or the proper and adequate recording of this resource by full archaeological excavation. This may result in a potential slight/moderate range of significance of effect in the context of residual effects on possible unrecorded archaeological resource.	Neutral
Landscape & Visual	The most notable visual impacts will occur at local community receptors, which account for three of the four Substantial–Moderate visual effect significance judgements. It should be noted that while the proposed turbines will be prominent built features viewed from the nearest surrounding local receptors. Overall, the Proposed Development is well accommodated within this broad landscape context and does not appear incongruous in terms of scale or function, particularly given the extensive areas of underlying peat bog. It is assessed the visual effects at receptors within the central and wider study area are Not Significant.	Neutral

3.3.2 Alternative Renewable Energy Technologies

Alternative sources of energy generation form part of the renewable energy development portfolio of the Applicant, and a number of options were considered at a high level prior to the Strategic Site Selection process.

Although the screening exercise was primarily based on identifying lands for onshore wind development; another alternative source of renewable electricity generation would be offshore wind energy.

The Proposed Development is a Joint Venture between SSE Renewables and BnM. Both SSE Renewables and BnM have a keen interest in offshore wind farms and have explored potential offshore sites. SSE Renewables is developing Arklow Bank Phase 2 project in the Irish Sea and BnM has recently launched an offshore partnership with Ocean Winds to identify and develop offshore wind energy opportunities around the coast of Ireland.

However, it is considered that due to delays with the regulatory process for offshore development, a combination of both onshore and offshore wind farm development will continue to be required to deliver on the ambitious renewable energy targets set out under CAP25 which include focusing on onshore wind energy developments to reach the 2025/2030 renewable energy targets. As such, the Applicant's primary focus is on onshore wind farms, and the Applicant will continue to explore potential development offshore in tandem with delivering suitable sites onshore such as the Proposed Project.

The Applicant is committed to playing a key role in helping the State achieve its CAP25 objectives while building upon its proven record of generating clean renewable energy to the national grid. As such, the option of an offshore project is not considered to be a reasonable alternative at this time.

Another alternative renewable energy source considered was solar which can be defined as the harnessing and conversion of sunlight into electricity using photovoltaic arrays (panels).

In order to achieve the same energy output from solar energy, a site would require a significantly larger development footprint due to the significant difference in capacity factors between solar and wind technologies and the footprint of the technology infrastructure. The capacity factor of solar energy is significantly lower than that of wind energy, requiring approximately three times the installed capacity of the Proposed Development to produce the same amount of energy.

A commercial wind farm project was preferred due to the significantly lower land take required to deliver comparable energy output to a solar farm and was thus considered to align better with the project objectives.

3.3.3 Strategic Site Selection

Bord na Mona (BnM) owns circa 80,000 hectares of land, primarily in the midlands of Ireland. An assessment of potential future uses of this landbank was published by BnM in 2011 in a document entitled 'Strategic Framework for the Future Use of Peatlands'. This report clearly identified the potential for the development of renewable energy (in particular wind energy) and other developments on BnM lands.

BnM's peatlands offer many advantages for the development of onshore wind farms, including:

- Industrial brownfield sites suitable for redevelopment;
- Of significant scale and present in large blocks;
- Open, unenclosed landscapes with good wind characteristics;
- Linked by rail or road passageways, suitable for cable connection;
- Generally flat and well drained, with minimal dangers of land slippage, and;
- Proven delivery of this type of development, as demonstrated by BnM's Bruckana, Mountlucas, Cloncreen, Derrinlough and Oweninny Wind Farms.

The Project Ireland 2040 National Planning Framework (NPF) identified a range of key future planning and development and place-making policy priorities for the Southern Region that includes:

> *" Harnessing the potential of the region in renewable energy terms in accordance with the capacity allocation targets set out ..., across the technological spectrum from wind and solar, in addition to biomass and wave energy"*

This key priority is restated in the first revision of the NPF published in April 2025.

3.3.3.1 Site Assessment Process

In order to identify sites within its landbank which might be suitable for wind energy development, BnM conducted a two-stage assessment process.

The first stage comprised the identification of a number of candidate sites via desk studies and on-site surveys of the landbank. Known constraints, derived from various industry and regulatory guidelines, available Geographical Information Systems (GIS) datasets and on-site surveys (carried out as part of the peat extraction activity), were then applied to the dataset, including:

- Planning Policy Context;
- Proximity to Sensitive Receptors;
- Proximity to the national electricity grid;
- Proximity to National and European Designated sites and onsite Environmental Sensitivities;
- Peat depths, and;
- Suitable wind speeds.

The second stage of the assessment was used to select the sites with the best potential to deliver a successful wind farm project by 2030 to be further developed via BnM's Joint Venture (JV) with SSE Renewables. This site-specific assessment was guided by the 2013 'Methodology for Local Authority Renewable Energy Strategies' report from the Sustainable Energy Authority of Ireland (SEAI) and informed by consultation with BnM's Works Management, Central Engineering, Construction, Ecology, Land and Property, and Planning teams.

Key criteria were selected for the site-specific assessment, which not only covered the broad range of issues which can arise from wind farm development but also allowed for direct comparison between candidate sites to determine their relative suitability. The site-specific selection criteria and an outline of the basis for assessment for each criterion are listed in Table 3-1 below. To facilitate the selection process, greater emphasis was placed on certain criteria viewed as critical to site suitability, including environmental sensitivity, grid access/capacity, CDP and zoning, and proximity to houses.

3.3.3.2 Site Selection Results

The application of the above criteria resulted in the selection of 8 potential candidate wind farm sites to be developed via the JV. These include the Proposed Site at Littleton Bog in Co. Tipperary, which is the subject of the present application, 2 other projects for which separate planning applications will be submitted in the coming months:

- Lemanaghan Bog, Co. Offaly;
- Garryhinch Bog, Co. Offaly and Co. Laois;

and 5 other sites for which the JV has commenced environmental surveys to potentially develop projects for planning consideration:

- Bellair Bog, Co. Offaly and Co. Westmeath;
- Derryfadda Bog, Co. Galway;
- Coolnagun Bog, Co. Westmeath and Co. Longford;
- Kilberry Bog, Co. Kildare, and;
- Cornafulla Bog, Co. Roscommon.

The JV intends to fully assess all these projects for suitability as all were considered to be viable sites for wind energy development. Each is a project in its own right which, if deemed suitable for planning consideration, will be subject to EIA. As such, a description of the reasonable alternatives studied which are relevant to each project and its specific characteristics, together with an indication of the main reasons for selecting the chosen option with regards to their environmental impacts will be provided in the EIAR accompanying the applications for same.

It is noteworthy that the process described in the preceding paragraphs is not a one-off assessment of the entire landholding available to BnM or its Joint Ventures in terms of its suitability for renewable energy developments. The site selection process is revisited in its entirety for each individual project and the criteria updated to suit the technology type proposed and to take account of any changes that have occurred (i.e. policy, legislative, environmental, etc.) since the previous site selection process was conducted.

3.3.3.3 Suitability of the Candidate Site

Littleton Bog was progressed for detailed assessment and planning consideration due to its relatively low potential for environmental effects and the close proximity to key transport routes which would provide environmental and project viability benefits. Table 3-2 below presents the findings of the site-specific assessment for the Proposed Littleton Wind Farm, and includes the basis for assessment and potential environmental effects associated with each of the key site selection criteria.

Table 3-2: Site Specific Selection Criteria, Basis for Assessment, and Findings for Proposed Littleton Wind Farm

Criterion	Basis for Assessment	Potential Environmental Effect	Proposed Littleton Wind Farm
Grid Access/ Capacity	Grid Access/Capacity means the potential of the National Grid to accommodate future projects on the network. The proximity of a project to suitable grid nodes (i.e., those with spare capacity) should facilitate the selection of a project for a viable grid connection offer	Direct: Land, Soil and Geology, Hydrology and Hydrogeology, Biodiversity. Indirect: Noise and Vibration, Population and Human Health	Circa. 30km from the newly constructed Ballyragget 110/38kV substation, which is now connected by a new 110 kV line to Coolnabacky 400/110kV substation. These works form part of EIRGRIDs Laois Kilkenny reinforcement project.

Criterion	Basis for Assessment	Potential Environmental Effect	Proposed Littleton Wind Farm
Wind Resource Assessment	The available wind resource (i.e., wind speed) directly translates into how much electrical output is available from the site.	Direct: Air Quality and Climate. Indirect: Air Quality and Climate.	The Irish Wind Atlas outlines that wind speeds in midlands bog groups are typically 7 – 8 m/s.
County Development Plans (CDP) and Zoning	County Development Plans typically indicate the areas of a county which are deemed preferred, open to consideration and not suitable for wind farm development.	Direct: Landscape and Visual, Cultural Heritage, Biodiversity. Indirect: Major Accidents.	The proposed turbines are within an area deemed "open for consideration" for wind farm development in the Tipperary County Development Plan 2021 - 2027 and accompanying Renewable Energy Strategy
Proximity to Houses	Proximity to houses refers to how close the proposed wind turbines are to sensitive receptors.	Direct: Population and Human Health, Noise and Vibration, Shadow Flicker. Indirect: Landscape and Visual.	Littleton wind farm is designed for turbine setback distance of 4 x tip height or greater.
Population Density	Proximity to houses refers to how close the proposed wind turbines are to sensitive receptors.	Direct: Population and Human Health, Noise and Vibration, Shadow Flicker. Indirect: Landscape and Visual.	Littleton wind farm is designed for turbine setback distance of 4 x tip height or greater.
Environmental Sensitivity	Environmental Sensitivity is the ecological sensitivity of the site based on proximity to sensitive areas within or around the site.	Direct: Biodiversity, Climate. Indirect: Water and Major Accidents.	No Natura areas in the site, low number of Natura sites in the wider area, mainly low value habitat on the site
Landscape Capacity/ Cumulative Impact	Environmental Sensitivity is the ecological sensitivity of the site based on proximity to sensitive areas within or around the site.	Direct: Biodiversity, Climate. Indirect: Water and Major Accidents.	No Natura areas in the site, low number of Natura sites in the wider area, mainly low value habitat on the site

Criterion	Basis for Assessment	Potential Environmental Effect	Proposed Littleton Wind Farm
Aviation	Airspace control and use to be considered. For the assessment, the criterion examines proximity of the site to local and regional airports (including Casement Aerodrome), proximity to National Motorway network, parachute zone, Military Operating Areas, etc.	Direct: Telecommunications, Aviation and Electromagnetic Frequency, and Major Accidents.	The site is at a significant distance from local and regional airports. It is outside critical low level Military Operational Areas. Although it is within 3Nm the M8, critical low level routes requiring referral to the AirCorps, it is noted that other windfarms have been consented and operate within a similar distance from motorways.
Land Use	Internal BnM consideration relating to alternative uses for each bog.	Direct: Cultural Heritage, Land, Soils and Geology, Hydrology and Hydrogeology, Biodiversity, Climate, Major Accidents.	A significant portion of the site has medium to low levels of peat. There are no other significant uses at the site.
Communications Infrastructure	Telecoms masts and signals in the vicinity and across the sites to be considered.	Direct: Telecommunications, Aviation and Electromagnetic Frequency.	There are 15 identified radio links in the vicinity of the proposed wind farm site. 4 of these belong to Eir, 2 belong to Enet, 1 belongs to ESB, 3 belong to Three, and 5 belong to Vodafone. There is no impact identified associated with these links.
Flood Plain Analysis	Flood Plain Analysis assesses the wind farm's location in terms of historical flooding data. It also considers if the site is pumped, or gravity drained.	Direct: Water and Major Accidents. Indirect: Traffic and Transportation and Major Accidents.	The overall risk of flooding posed at the Site is assessed to be low, and all vulnerable infrastructure will be located at or above Flood Zone C elevations.
Supporting Infrastructure	Proximity to national and regional road network sites with better road access require less modifications or upgrade to the local infrastructure to facilitate construction or delivery of turbine components to site.	Direct: Traffic and Transportation. Indirect: Noise and Vibration, Air Quality, and Climate.	The nearest motorway to the Littleton site is the M8 which forms a large part of the Turbine Delivery Route (TDR) and departs at Junction 4 to join the R693 regional road.

Criterion	Basis for Assessment	Potential Environmental Effect	Proposed Littleton Wind Farm
			The R639, which forms part of the GC route and the TDR (approximately 4.6km), running in the southwest direction, it passes approximately 1km west of the site and crosses the northern section of the development. The L2201 local secondary road links Ballymoreen to Ballinunty. Vehicles will utilise this road to gain access to the southern section of the site during the construction stage. The L4153 local road at Derryhogan is a single carriageway secondary local road. It is proposed to have an existing bog operations vehicular access road crossing point on this road.

3.3.3.4 Phase 4 - Wind Farm - Site Validation

The proposed development site was further examined under the following headings to confirm its suitability for wind energy development. The main policy, planning and environmental issues considered for the validation of this wind farm site included:

- Consistently high average annual wind speeds;
- Obtainable, and commercially viable grid connection;
- Compliance with Planning Legislation
- Located outside areas designated for protection of ecological species and habitats;
- Adjacency of residential properties;
- Site topography and access for turbine delivery and construction activities; and
- Level of Visual Impact.

The above exercises, based on several key environmental, technical and policy-related criteria, determined that the proposed Littleton site represents an optimal location for the proposed development in Tipperary. The proposed development site has satisfied key criteria required for successful wind energy development and these are presented in Table 3-3.

Table 3-3: Key Criteria required for Successful Wind Energy Development

Suitability Criterion	Proposed Development Site
Wind Resource	The predicted wind speeds at the Site vary between 7.5 and 8 m/sec as shown in Sustainable Energy Ireland's Wind Atlas.
Proximity to Grid	The site will connect into the existing Ballyragget Substation, via c. 30.9km of cabling from the proposed on-site 110kV substation to Ballyragget Substation.
Compliance with Planning Designation	As set out within EIAR Chapter 2 - Background to the Proposed Development, the Tipperary County Development Plan 2021 - 2027 marks the site as being within an area 'Open for Consideration'. The proposed development will contribute towards the achievement of Ireland's national targets pertaining to climate change and renewable energy production.
Avoidance of Environmental Designations	There are no designated sites located within or in close proximity to the Site. The Lower River Suir SAC (Site Code: 002137) is located ~9.4km west of the Site and is hydrologically connected to the Site via the Drish River (and its associated tributaries). This SAC consists of the freshwater stretches of the River Suir immediately south of Thurles and the tidal stretches as far as the confluence with the Barrow and Nore near Cheekpoint, Co. Waterford. The length of the shortest hydrological flowpath between the Site and the SAC is greater than 17km. The Cabragh Wetlands pNHA (Site Code: 001934) is located ~10km west of the Site and is hydrologically connected to the Site via the Drish River and the River Suir. The length of the hydrological flowpath between the Site and the pNHa is greater than 18km. Other designated sites within 10km of the Site include: • Kilcooly Abbey Lake pNHA (Site Code: 00958) located ~5km to the east. • The Loughans SAC and pNHA (Site Code: 00407) is located ~8.5km to the northeast. • Spahill and Clomantagh Hill SAC and pNHA (Site Code: 000849) is located ~10km northeast of the Site. • Killough Hill pNHA (Site Code: 000959) is located ~8.5km west of the Site. • Laffansbridge pNHA (Site Code: 000965) is located ~4km south of the Site.
Separation distance from dwellings	Minimum setback distance of 4 times tip height of the turbines to non-involved landowers was adopted which significantly exceeds the separation distance suggested in the Wind Energy Development Guidelines (2006).
Site accessibility	Primary site access for the delivery of turbine components and access required for the maintenance of turbines during the operational phase of the Proposed Development can be achieved from 6 no. entrance points detailed in Chapter 4 - Description of Development. The entrance that will be used for the TDR, will be Site Access point 6 to the north of the site along the R639.
Level of Visual Impact	The landscape character and landscape sensitives of the site were assessed and it was considered that the site has the capacity to absorb a wind farm of scale.

3.3.4 Constraints-Led Design Approach

Following the selection of the Littleton Site from the Site Screening Process outlined in the Section above, a design process commenced. From the outset of this process, a constraints led design approach was adopted by the Applicant and the wider project design team. Constraints led design is a commonly used, best practice approach employed in wind farm design. In this approach, environmental sensitivities within the proposed development site are identified and avoided by the design team with a view to obtaining suitable areas in which wind turbines may be located. The resulting area is referred to as the 'developable area'. Lands outside of this developable area were not considered for the placement of wind turbines or related ancillary infrastructure as they have been deemed unsuitable.

The identification of lands deemed unsuitable occurs through the gathering of information from desk-based assessments, field surveys/site visits, and consultation with key stakeholders and statutory agencies (e.g NPWS, OPW, IFI.) Through this effort the key environmentally sensitive features (also referred to as sensitive receptors) are mapped and the process of applying design constraints commences. Sensitive receptors commonly include, inter alia, Special Areas of Conservation (SAC), Special Protection Areas (SPAs) or Natural Heritage Areas (NHAs). However, other factors are also taken into account which can include hydrological features such as river or streams; areas prone to flooding; places of archaeological or cultural heritage significance; sensitive ecological habitat; steep terrain or areas which may be susceptible to landslides; deep peat and private dwellings.

Once all known environmentally sensitive receptors within the site were accurately recorded and mapped, suitable setback buffers were applied. The size of the setback buffer is related to the sensitivity of the individual receptor as established in the Wind Energy Development Guidelines 2006 (Please refer to Chapter 6 – Biodiversity and Chapter 9 – Hydrology and Water Quality) and scientific best practice. Any lands within these areas or associated buffers were avoided and excluded from the developable area. Avoiding Important Environmental Features (IEFs) and/or sensitive habitats was a key design constraint considered during the iterative design process. However, as outlined in EIAR Chapter 4 - Development Description and the related Appendices, other key factors were considered including proximity to neighbouring property/dwellings, feedback from the community and technical/functional specifications and requirements (e.g. the application of setback buffers electrical power lines, public roads, neighbouring property boundaries as well as ensuring compliance with utility engineering requirements, in particular ESBN and Eirgrid functional specifications for MV and HV grid infrastructure) were also considered (Please refer to the relevant chapter of this EIAR, for example Chapter 15 – Material Assets (includes Traffic and Transportation)) .

The preliminary developable area was determined before progressing the detailed design of the Proposed Development. This area evolved throughout the design process as additional survey information was collected during the EIAR process. Additional constraints were added as they became known following the completion of more detailed environmental studies, field surveys and feedback received from consultation (please refer to EIAR, Chapter 2 - Background to Development). All proposed wind turbines and infrastructure associated with the Proposed Development were sited as far as is possible to avoid the wetland areas and other key habitats which have developed following the implementation of the Phase 1 Rehabilitation Measures on site.

The following sections discuss the evolution of the Design Iterations for the proposed development in Littleton, along with the key influences and constraints for turbine locations and the positioning of supporting infrastructure.

3.3.5 Alternative Turbine Numbers, Layout and Design

The design of the Proposed Development has been an informed and collaborative process from the outset, involving the engineers, environmental, hydrological, geotechnical, archaeological and transport specialists. The objective of which is the avoidance of significant environmental effects while designing a project which is technically feasible and maximising wind resource. Throughout the preparation of the EIAR, the layout of the Proposed Development has been revised and refined to take account of the findings of all site investigations and surveys, consultation and impact assessment, all of which have brought the design from its first initial layout to the current proposed layout.

Constraints and environmental sensitivities were first identified, and buffers applied in order to determine appropriate areas within the site to accommodate development. This constraints exercise resulted in a developable area being defined. Once the developable area is established, the siting requirements of the wind turbines in terms of separation distances etc. are considered and a preliminary layout can be developed for the site. An extract of the constraints mapping for the Site is presented in Plate 3-1 and included the following buffers:

- Residential dwellings plus a minimum 800-metre buffer (4 x tip height achieved from non-participating properties houses);
- European (Natura 2000) Designated Sites plus 200-metre buffer;
- Sensitive ecological receptors and habitats, including wetland areas and other key habitats that have developed since the implementation of the Phase 1 rehabilitation measures;
- Telecommunication Links plus operator specific buffer;
- Rivers, Streams and Lakes plus 50-metre buffer;
- Archaeological Sites or Monuments - 'Zone of Notification';
- Restricted area either side of M8 motorway to avoid conflict with Irish Air Corp low level flight route.

A comparison of environmental effects of following this design approach and not following it, i.e. applying mitigation by design versus a design which does not consider the various environmental factors of the receiving environment is presented in Table 3-4.

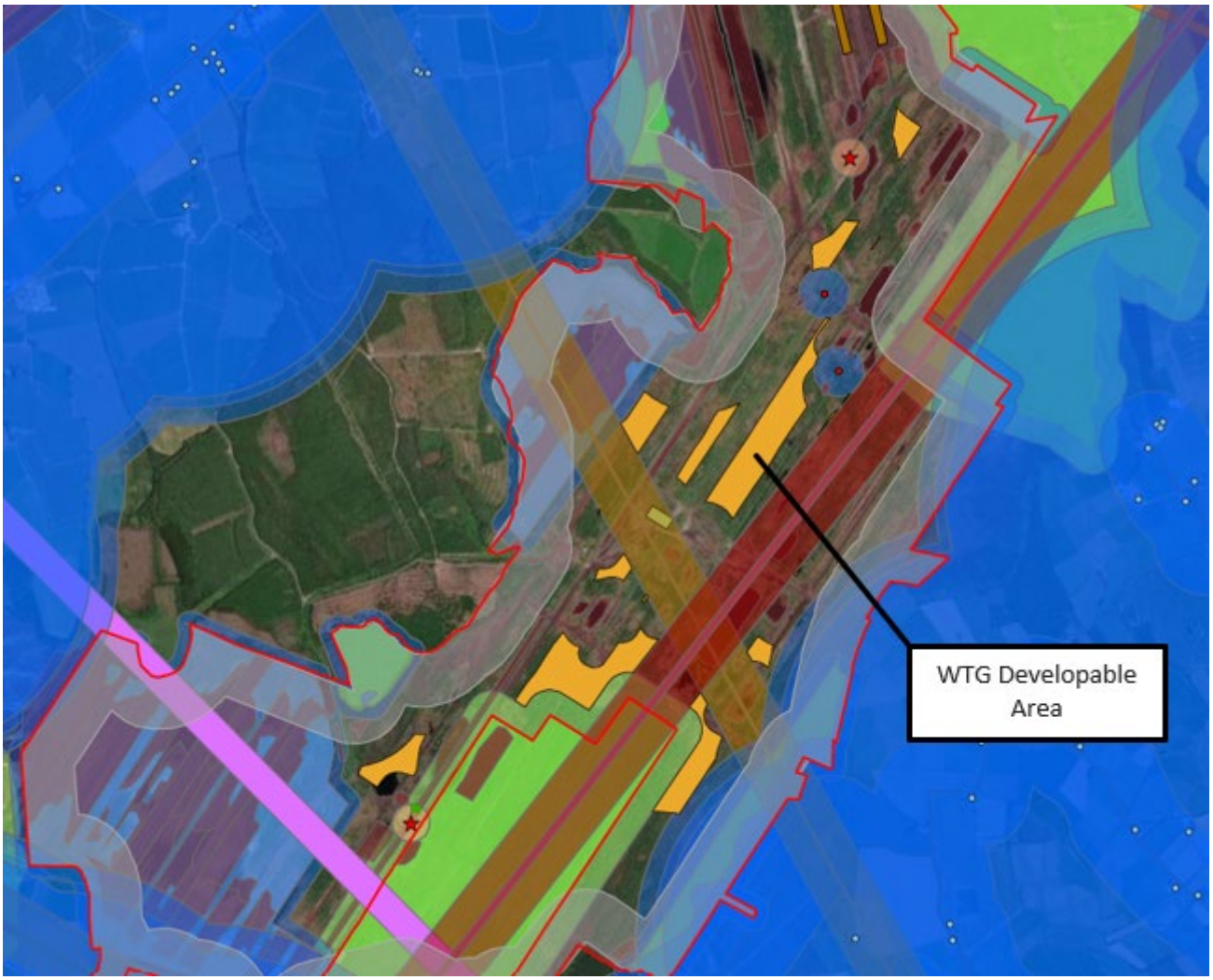

Plate 3-1: Example Constraints Map with WTG Developable Areas

Table 3-4: Comparison of Potential Residual Environmental Effects - Mitigation by Design

Environmental Consideration	Mitigation by Design Utilised in the Littleton Wind Farm Project	Potential Effect if Mitigation by Design is not Included
Residential Amenity	The Applicant set a minimum of 500m set back from all inhabited dwellings in line with the Wind Energy Development Guidelines (WEDGs 2006) and with regard to the Draft WEDGs 2019 which prescribes a mandatory setback of 500m and a recommended setback distance of 4 times the top height. Following completion of layout optimisation, a separation distance of 800m (4 times tip height) between wind turbines and residential properties was achieved. The closest dwelling is located 851 m from the nearest proposed wind turbine.	Potential for effect to residential amenity due to noise, vibration and dust during the construction stage. Further potential effect to residential amenity during operations due to visual effect and noise if an appropriate setback distance is not applied.
Flora and Fauna	Avoidance of designated sites and mitigation designed to avoid potential effects on any qualifying interest, species, and/or sensitive habitats. As outlined in Chapter 6 - Biodiversity and related Appendices, areas of higher habitat value were avoided. Drainage Design applies SuDS to protect watercourses. Implementation of Riparian Buffer Zones of at least 50m between the proposed development and watercourses. Integration of peatland management into the project. Please refer to Appendix 4.1, Construction Environmental Management Plan (CEMP)	Potential for effect on hydrology and possible water quality and hydro morphology effects downstream. Potential for loss of habitats of high ecological value.
Ornithology	Positioning the turbines within more open areas away from busier flight paths. Limit the need to remove habitat with high potential to support birds e.g., placing turbines in areas of higher historic burning rather than in higher quality meadows. Isolation of areas of high-quality grassland / heath habitat to be retained and managed. Enhancement of agricultural lands for birds, refer to Chapter 7 - Ornithology and the BEMP.	Potential effect to avifauna associated with the construction phase including possible deterioration of habitats and disturbance or displacement of birds (see Appendix 7.3, Volume 3 - Collision Risk Model).

Environmental Consideration	Mitigation by Design Utilised in the Littleton Wind Farm Project	Potential Effect if Mitigation by Design is not Included
Soils & Geology	Location and alignment of hardstands and roads sympathetic to the natural topography in order to reduce cut/fill and to limit effects on geology and soil stability. A detailed assessment of peat depths and trial pits/site investigation was undertaken to inform the design process of the Site which sought to avoid areas of deep peat. Layout is appropriately set back from known sensitive geological features e.g fault lines and areas of high landslide susceptibility. Please refer to Chapter 8 - Land, Soils and Geology for further information.	Alternative development footprint would result in greater volumes of overburden to be excavated. Potential for development on ground with unsuitable slope.
Hydrology and Water Quality	Minimum 50m set back of infrastructure from all watercourses was applied where reasonably possible. Adaptation of design to existing hydrological regime (streams and drainage channels) and inclusion of SuDS and comprehensive surface water management plan for the site. Please refer to Chapter 9 - Hydrology, Hydrogeology and Water Quality.	Potential effect to the existing hydrological regime in the absence of SuDS. Potential for runoff to directly discharge to streams. Potential migration of silt or petrochemicals to watercourses. Potential effect on water quality and aquatic biodiversity. Potential effect on designated sites downstream.
Noise & Vibration	Ensure compliance with the relevant guideline limits for noise. An 851 m setback between the turbines and residential receptors has been achieved which will assist in maintaining residential amenity at local dwellings.	Potential for effect to residential amenity at nearby dwellings due to reduced separation distances.
Shadow Flicker	Shadow flicker detection systems will be installed in turbines to avoid shadow flicker at nearby dwellings, in line with the Draft Revised Wind Energy Development Guidelines (2019). Please refer to Chapter 12 – Shadow Flicker for further information relating to this.	Potential effect on residential amenity due to shadow flicker at nearby dwellings if control measures are not applied.
Cultural Heritage	Design takes cognisance of nearby recorded monuments and avoids them and their zone of notification. See Chapter 14 - Archaeological, Architectural and Cultural Heritage.	Potential effect on cultural heritage assets if infrastructure is placed in proximity.
Material Assets	On site borrow pit and balance of cut and fill within the Site in order to reduce road haulage.	Potential for greater traffic volumes during construction phase if material usage on site is not balanced.

Environmental Consideration	Mitigation by Design Utilised in the Littleton Wind Farm Project	Potential Effect if Mitigation by Design is not Included
Traffic and Transportation	Balance of cut and fill within the site to reduce road haulage – please refer to Chapter 2 – Description of development, and Chapter 15 – Material Assets (include Traffic and Transportation).	Potential for greater traffic volumes during construction phase if material usage on site is not balanced and large volumes of external material are required.
Landscape & Visual	Design consideration of sensitive visual receptors in the greater area and uses the natural topography to reduce visual effects. Please refer to Chapter 13 - Landscape and Visual Impact.	Potential negative visual effect on sensitive visual receptors and potential effect on residential amenity if not considered in the design of the wind farm.

3.3.5.1 Wind Farm Design Iterations

Alternative layouts for the Proposed Development were developed in an iterative design process which aimed to avoid environmental sensitivities, minimise potential environmental effects both on and off site and to maximise the wind potential on site. The design has been carried out in accordance with industry guidelines and best practice, namely the Department of Environment, Heritage and Local Government's (DoEHLG) Wind Energy Development Guidelines (2006), The Department of Housing, Planning and Local Government's (DoHPLG), and the Irish Wind Energy Association Best Practice Guidelines (2012). In accordance with best industry practice and professional judgement, the design process of the Proposed Development also has had regard to the Draft Revised Wind Energy Development Guidelines (2019) particularly in the aesthetic considerations in the siting and design of the wind farm and in terms of mitigation by design including increased setback from nearby dwellings and the policy regarding zero shadow flicker.

The design of the Proposed Development was an iterative process which considered a range of alternative design throughout the evolution of the project. FT worked closely with the clients in house Electrical Engineers for design of the Grid Connection. The design iterations were influenced by potential environmental effects identified throughout the environmental assessment, leading to the evolution of the development area of the project and the establishment of the final design as proposed. 4 no. milestone design iterations were considered throughout the progression of the project, shown in Table 3-5.

A comparison of all design iterations is presented at Figures 3.1 to 3.5 which are located in Volume 4 of this EIAR.

Table 3-5: Alternative Wind Farm Design Options

Layout No.	No. of Wind Turbines	Tip Height (m)	Total Approx. Installed Capacity (MW)
Design Iteration 1	20	200 - 220	124 MW
Design Iteration 2	14	190 - 200	87 MW
Design Iteration 3	11	200	68.2 MW
Design Iteration 4	11	200	68.2 MW

In addition to the milestone design iterations set out in the above table, numerous interim wind farm design iterations were considered and assessed throughout the EIAR process. These are detailed in Table 3-5 below which sets out the timeline of wind turbine layout design development.

Table 3-6: Windfarm Design Development Timeline

Timeline	Description
Q1 2021	Initial site boundary and preliminary wind turbine layout options with a range of turbine numbers and dimensions for initial consideration. Inclusion of Longford Pass and Lanespark to Site boundary study area.
	Initial Layout Option 1 – 200T_170R_14WTGs: Layout comprising 14 no. turbines with a tip height of 200 m and rotor diameter of 170 m.
	Initial Layout Option 2 – 220T_170R_13WTGs: Layout comprising 13 no. turbines with a tip height of 220 m and rotor diameter of 170 m.
	Initial Layout Option 3 – 200&220T_170R_14WTGs_TH Hybrid at Littleton: Based on Option 1 layout but with a mix of tip heights at Littleton Bog with 220m tip heights for several turbines in the core of the Littleton cluster. Proposed following preliminary landscape and visual impact assessment workshops.
	Initial Layout Option 4 – 200&220T_170R__14WTGs_220T at Littleton_200T at Lanespark: North/South split hybrid between Option 1 and 2 with 220m tip heights at Littleton and 200m tip heights at Lanespark. Proposed following preliminary landscape and visual impact assessment workshops.
	Substation location options identified within Littleton Bog for potential grid connection routes within a connection route study area.
Q2 2021	Design Iteration 1 turbine layout comprising 20 turbines with a tip height of up to 220 m. This represented a maximised layout for EIAR scoping purposes.
Q4 2021	Consideration of 4 no. alternative substation location options following preliminary studies within Littleton Bog and Longford Pass areas to serve alternative grid connection routes to Thurles or Kill Hill substation connection options.
Q1 2022	Revised 15 no. turbine layout for assessment issued by client. Includes 3no. Turbines in Lanespark and three turbines in Longford Pass.
	14 no. turbine layout with a range of hub heights and tip heights. Hub height ranges from 112m to 167m. 164 m rotor diameter.
	Identification of preferred onsite substation within upper Littleton Bog following environmental surveys and site investigation works.
	Longford Pass turbines removed from consideration to avoid Department of Defence motorway corridor constraint.
	Design Iteration 2 turbine layout comprising 14 turbines with a tip height ranging between 190 - 220 m.

Timeline	Description
Q2 2023	Identification of potential biodiversity enhancement lands for consideration.
Q3 2023	Design Iteration 3 layout comprising 11 turbines with a tip height of 200 m.
Q2 2025	Design Iteration 4 layout comprising 11 turbines with a tip height of 200 m and a rotor diameter of 162 m.

The layout of the turbines and associated infrastructure for the Littleton Wind Farm evolved over four main design iterations, each shaped by progressively more detailed site assessments and technical feedback. The process began with the establishment of the developable area and an initial layout (Preliminary Design - Figure 3-1 of Volume 4), which included a 14-turbine arrangement.

As the design progressed through iterations 1, and 2 (Figure 3-1, and Figure 3-2 of Volume 4), refinements were made in response to environmental, ecological, geotechnical and hydrological surveys, noise and shadow flicker modelling, and feedback from the project team, Developer, local residents, service providers, environmental stakeholders, and landowners. Enhanced habitat mapping, peat probing, and ground investigations - along with consideration of site-specific constraints such as watercourses, and ecologically sensitive areas - also informed these revisions.

Further design refinements through Design Iteration 3 (Figure 3-3 of Volume 4) were required as a number of turbines were guided by input from ecologists, geotechnical and civil engineers, and hydrologists. The final design balances technical feasibility with environmental responsibility, incorporating considerations such as access feasibility, buffer zones (e.g. habitat buffers), and updated ground condition data. The project philosophy of mitigation by avoidance was central to achieving a layout with the least potential environmental effect.

A comparison of the potential environmental effects associated with the various design iterations is presented in Table 3-7.

3.3.5.1.1 Design Iteration 1

Having undertaken desktop and initial site assessments, several preliminary layouts were developed by the Applicant for consideration by the EIAR team. Turbines were distributed relatively evenly across the Application Site accounting for multiple potential points of access, multiple grid connection options, and numerous potential substation locations. The emerging layout options were based on a Turbine Tip height of 200 - 220m.

Following the establishment of a wind turbine developable area for the Littleton Wind Farm, and as part of the design alternative process an early stage layout (Design Iteration 1), as show in Figure 3.1, Volume 4 of this EIAR, was established. This layout comprised a total of 20 turbines and was determined through a variety of desktop studies, available data and initial site surveys (such as engineering and hydrological walkovers). This layout focused on capitalising on wind speeds whilst avoiding the any initially identified sensitivities and constraints, and as such positioned turbines within the Developable Areas.

Potential available and suitable turbine models for the site also informed the transition from Preliminary Design to Design Iteration 1 and a turbine with a tip height of 200m and rotor diameter of 170m was identified as the most suitable with the balance between facilitating renewable energy development to meet national and local policy objectives and achieving an appropriate layout within the site context being at the forefront of this choice. At this stage a number of potential substation compound sites were identified for further investigation and refinement in later design iterations.

3.3.5.1.2 Design Iteration 2

Following the preparation of DI2 further detailed surveying and assessment of the site was conducted which included, inter alia, ecology surveying, noise monitoring surveys, the preparation of a Collision Risk Model (CRM) and Landscape and Visual Impact Assessment (including the preparation of photomontages). Additionally, feedback from initial public consultation and EIA Scoping had been received. This new design of the Littleton Wind Farm Project (DI2) also considered wind ellipse based on an 85m blade length (assuming a 200m tip height) to establish optimal turbine spacing. As such, on the combined basis of the above factors alterations were made to the design of the Proposed Development which saw the number of turbines reduced to 14 and some turbines moved (as illustrated in Figure 3.2, Volume 4).

3.3.5.1.3 Design Iteration 3

The Design Iteration 3 turbine layout is represented in Figure 3.3, Volume 4. In response to ongoing consultations and assessments a number of further refinements were made to form the design iteration, DI3. These key changes included micro siting of specific turbine locations following detailed contemporary CRM and ecological constraints identified following site surveys.

As discussed in the introduction to this section, a number of turbine parameters were considered with each of the different design iterations. Considerations were given to the implications of using differing turbine heights, for instance the relationship between turbine height and density (number of turbines) required to achieve a particular output was a key design consideration. For instance, a decreased turbine tip height (150-190m) with a greater number of turbines (between 14 and 20) versus an increased turbine tip height (200 - 220m) with a lesser number of turbines (between 11 and 14).

3.3.5.1.4 Design Iteration 4

Design Iteration 4 is shown in Figure 3.4, Volume 4. This turbine layout represents the final fixed turbine layout used to form the basis of the overall engineering design shown in the planning application. As part of this layout development a number of factors influenced the final frozen layout:

- Completion of civil engineering infrastructure design including the identification of infrastructure such peat deposition areas, drainage infrastructure, BEMP areas and recreational amenity infrastructure;
- Up to date constraints analysis including contemporary collision risk modelling data, flood risk assessment and increased setbacks from third party lands resulted in minor adjustments of some turbine locations within the central Littleton Bog site.
- This layout was presented to ACP and the NPWS during final EIAR consultations with feedback from same considered.

Table 3-7: Comparison of Potential Residual Environmental Effects of the Wind Farm Design Iterations

Environmental Consideration	Design Iteration 1	Design Iteration 2	Design Iteration 3
Air & Climate	More turbines increase the potential to maximise the use of the site wind resource and the opportunity to further reduce the country's dependence on fossil fuels. However, more turbined would require extensive civil works with associated potential for vehicle emissions and dust emissions due to an increased volume of material and turbine component deliveries to the site during the construction phase.	Lesser civil works required for construction. Fewer turbines reduced the potential to maximise the use of the site wind resource and the opportunity to further reduce the country's dependence on fossil fuels.	Significant reduction in civil works required by the reduction in number of turbines.
Noise & Vibration	Turbine array located closer to sensitive noise receptors and large number of turbines has greater potential for noise effects.	Turbine array located further from noise receptors and decreased number of turbines has less potential for noise effects.	Reduced number of turbines on Site resulting in less impact regarding noise.
Biodiversity	Larger development footprint therefore, increase overall habitat loss.	Smaller development footprint would have resulted in reduced habitat loss within the constrained-out area i.e. developable area.	Smaller development footprint resulting in a reduced habitat loss within the constrained-out area i.e. developable area.
Ornithology	Large number of turbines led to possible increase in potential for displacement of birds.	In response to CRM results and to potentially improve CRM results an alternative location for T4 east of previous location was proposed, reducing risk of bird collision.	Turbine locations T8 and T6 were relocated in DI3 following discovery of a hen harrier roost south of T8.
Land, Soils, Geology	Larger development footprint no. of turbines would result in greater volumes of soil and subsoil to be excavated and removed to dedicated onsite spoil management area.	Decreased no. of turbines, minimizing volumes of soil and subsoil to be excavated and removed to dedicated onsite spoil management area.	Decreased no. of turbines, minimizing volumes of soil and subsoil to be excavated and removed to dedicated onsite spoil management area.

Environmental Consideration	Design Iteration 1	Design Iteration 2	Design Iteration 3
Hydrology & Water Quality	Neutral (the larger area of hard surfaces would still be designed to minimise hydrological impacts)	Neutral (the marginally smaller area of hard surfaces would still be designed to minimise hydrological impacts).	Neutral (the marginally smaller area of hard surfaces would still be designed to minimise hydrological impacts.
Population & Human Health	No material environmental difference for population or human health.	No material environmental difference for population or human health.	Turbine array located further away from sensitive receptors.
Material Assets	Neutral – no telecommunication links or aviation in the area	Neutral – no telecommunication links or aviation in the area	Neutral – no telecommunication links or aviation in the area
Traffic & Transport	Potential for greater traffic volumes during construction phase due to greater earthworks requirements due to large number of turbines.	Potential for lower traffic volumes during construction phase due to smaller number of turbines.	Neutral
Archaeology & Cultural Heritage	Larger development footprint would increase the potential for impacts on unrecorded, subsurface archaeology. However, shallow soils associated with rocky environment reduces the potential.	Smaller development footprint would decrease the potential for impacts on unrecorded, subsurface archaeology.	Neutral
Landscape & Visual	Greater visual intrusiveness due to location of turbines along mountain ridgelines.	Turbines T3 and T9 causing a perception of the wind farm 'spilling out' of the natural topographical mountain basin thereby creating greater visual intrusiveness.	Turbine array layout is such that it capitalizes on the natural screening created by land topography of the mountain basin.

3.3.6 Alternative Construction Methods

The construction methods for any wind farm are not unique in the context of ground preparation, foundation installation and turbine erection. When considering the construction methodology for the Proposed Development consideration was given to the site investigative surveys undertaken and the most appropriate means of constructing the onsite infrastructure without allowing for significant environmental effects. Foundations for wind turbines will be gravity and piled foundation types. The site specific data has informed the likely construction methods that will be employed for the groundwork and foundation installations as well as the road and handstand designs. The construction methods that will be employed are not unique potential sources of contamination and so the chosen options are considered neutral.

3.3.7 Alternative Transport Routes and Site Access

Wind turbine components (blades, nacelles and towers) are not manufactured in Ireland and therefore must be imported from overseas and transported overland to the Site. Alternative transport routes to the Site were considered in relation to turbine components, general construction-related traffic, and site access locations.

Foynes was selected as the port of entry for the proposed Development because of its availability, proximity to the site and connectivity to the National Motorway Network and largely obstruction free route and the least requirement for third party land.

Given the sites proximity to the M8 motorway, this was going to constitute a large part of the proposed turbine delivery route. However, a closer analysis of the appropriate exit from the motorway and local roads to form part of the TDR was required.

The Applicant appointed Pell Frischmann to undertake this work. Ultimately, the most appropriate (and Proposed TDR) was identified to exit the M8 motorway at Junction 4 - Urlingford, briefly onto the R693 and to travel to the site via the R639 and gain entry to the site via its northern access point (identified as point 6). This option was selected as it is located closer to the Site and road connections between the Port of Entry of Foynes and the Proposed Development are dominated by national road infrastructure and as such reduce the requirement for third party land take and / or remediation work on the Turbine Delivery Route and involve the least amount of ancillary works (for example interference/road widening/vegetation clearance/street furniture removal/powerline diversion).

Of the access points identified, the optimal point of access for the TDR comes to the site from the North along the R639. The site access is a new proposed access point located near the northern boundary of the site along the R639 regional road.

The most viable turbine delivery / abnormal load route to Site was determined as follows:

- Loads will exit the Port of Entry (PoE) of Foynes Port and join the N69 heading east;
- At Limerick, they will join the N18 heading northeast and merge onto the M7;
- Loads will exit at Junction 17 Portlaoise Interchange and perform a U-turn to re-join the M7 heading southwest;
- They will merge onto the M8 and continue southwest;
- At the M8 Junction 4 East Roundabout loads will turn left to join the R693;
- At the following roundabout loads will turn right onto the R639 then drive through Urlingford;
- To the southwest of Urlingford loads will turn left at the proposed site entrance.

Further details on the proposed TDR are contained in Chapter 4 - Development Description and Chapter 15 – Material Assets (including Traffic and Transportation).

3.3.8 Alternative Grid Connection Routes

Alternative grid connection routes considered by the Applicant and EAIR team are shown in Figure 3-6, Volume 4.

All options consist of an underground connection as this is the preferred method as set out in the Draft Revised Wind Energy Development Guidelines:

> *"In general, it is considered that underground grid connections for wind energy projects are the most appropriate environmental and/or engineering solution, particularly in sensitive landscapes where the visual effects need to be minimised. Therefore, this should be the default approach. However, there may be cases where specific ground conditions would prevent this, e.g. in upland locations where peat stability issues can arise form large-scale excavation."*

Ground conditions along the local public roads were observed to be favourable for underground cables. Therefore, an option for an overhead line connection was not examined by the Applicant.

When considering an appropriate substation to connect the proposed Littleton Wind Farm to the national grid, substations in proximity to the Site were identified and a feasibility study was carried out to identify which substation was the most appropriate from an environmental and technical perspective.

Considering ESB/EirGrids' Nodal Assignment rules which indicate that applications above 10MW will be assumed to connect to a 110kV node and new 38kV nodes (such as the proposed on-site substation) will be assumed to connect to a 110kV node, the 38kV substations in proximity to the site were discounted from the study as not being reasonable alternatives. Therefore, the following options were shortlisted: Thurles 110kV Substation, Killhill 110kv Substation and Ballyragget 110kV Substation.

A review of grid capacity in this region by the applicant and informed by EIRGRID published data, indicated that although Ballyragget was located at a greater distance than other 110kV substations in the area, the greatest capacity in the network for this scale of wind development would be at Ballyragget. This is as a result of the significant grid upgrade works recently completed as part of the Laois Kilkenny reinforcement projects which links the 110kV network back to the 400kV network, offering unique access to the 400kV network in the region.

Following the selection of the substation node for connection to the national grid, alternative grid routes were considered from the proposed on-site substation to the Ballyragget 110kV substation. Three potential grid route options were considered and are illustrated in Figure 3.6, Volume 4.

A number of options were considered with regard to the grid connection's crossing of the Nore River and SAC near Ballyragget with horizontal directional drill being the preferred approach to minimise potential impacts on the SAC.

3.3.9 Alternative Substation Locations

A number of on-site substation locations were considered as part of the Littleton Wind Farm project. Initially, 4 no. substations were considered throughout the development site, 2 being to the north and 2 being to the south of the Application Site as illustrated in Figure 3.8 of Volume 4 of this EIAR. This aligned with DI1 and the wide range of potential grid connection options to Killhill, Thurles and Ballyragget associated with same.

Following further site investigations, technical analysis/assessment and the identification of Ballyragget as the preferred grid connection options, further refinements were made. The potential substation options to the south were omitted, as the northern options were more appropriate and located closer to the road infrastructure being utilised for the GCR. Additionally, options towards the Longfordpass Bog were also discounted at this stage due to constraints. As such, options for DI2 were focused around a specific area within the northern part of Littleton Bog.

Following further refinement and site investigations, an area within the northern part of Littleton Bog was selected as the optimal and most appropriate location for the on-site substation. As such, this was brought forward as DI3 and forms part of the Proposed Development.

3.3.10 Alternative Borrow Pit Locations

A comprehensive borrow pit identification exercise was undertaken as part of the Project design process to reduce the volume of imported material needed and therefore, HGV traffic on the local road network.

This included desk based reviews of a number of key criteria including Geological Survey Ireland mapped quaternary geology, bedrock geology, crushed rock potential, karst distribution, groundwater vulnerability etc. Please refer to Chapter 8 and associated Figures in Volume 4 of this EIAR for details of geological data in the borrow pit study area. This information along with mapped environmental constraints, site investigation data, and preliminary noise modelling studies informed the final selection of the proposed borrow pit location.

The location of the proposed Borrow pit stood out as most suitable and least impactful location of all the areas with high crushed rock potential due to its distance from environmental receptors and neighbours, the large extent of potential crushed rock resource and its close proximity to the main site access, central access track, main construction compound and substation compound.

The design of the borrow was refined throughout the design process in alignment with the development of material balance calculations as the overall infrastructure design emerged. The borrow pit design was also assessed for potential construction stage noise impacts through modelling which informed the final design and footprint of the borrow pit to ensure no significant adverse effects on local residents during the construction phase.

3.3.11 Alternative Mitigation Measures

Mitigation by avoidance has been central to the Proposed Development's evolution. By avoiding the ecologically sensitive areas of the Site, the potential for environmental effects is limited. As noted above, the site layout aims to avoid any environmentally sensitive areas through the application of site-specific constraints. Where loss of habitat occurs in the Site, this has been mitigated with the proposal of enhancement lands.

The alternative to this approach is to encroach on the environmentally sensitive areas of the site and accept the potential environmental effects and risk associated with this. The best practice design and mitigation measures set out in this EIAR will contribute to reducing any risks and have been designed to break the pathway between the Site and any identified Receptors.

3.4 Conclusion

This chapter of the EIAR has described the reasonable alternatives considered throughout the development process for the proposed Littleton Wind Farm in terms of project design philosophies, technology, size and scale for the development. This Chapter sets out the evolution of the Proposed Development and the alternatives considered. The section details the strategic site screening process i.e. the high-level considerations in finding a suitable site for a renewable energy project.

The alternative layouts of the Proposed Development were established through the project philosophy of mitigation by design. Alternative density and scales were considered, and the potential environmental effects of various alternative turbine scales and numbers were compared. Feedback from EIAR technical consultation and community engagement was also taken on board by the Applicant in the development of the design.

Alternatives were also considered for other individual elements of the Proposed Development including the grid connection route and turbine delivery route. These elements were arrived at through the avoidance of potential environmental effects as detailed in the comparisons provided throughout this Chapter.

The final proposed layout of the Littleton Wind Farm as assessed throughout this EIAR is thought to be the optimal design which minimises effects on the receiving environment, while providing significant renewable electricity to the national grid, in line with national energy and climate policy.

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