3.0 REASONABLE ALTERNATIVES

3.1 INTRODUCTION

This chapter of the Environmental Impact Assessment Report (EIAR) contains a description of the reasonable alternatives that were studied which are relevant to the project and its specific characteristics and provides an indication of the main reasons for the option chosen, taking into account the effects of the project on the environment.

In 2014, Environmental Impact Assessment (EIA) Directive 2011/92/EU was amended by Directive 2014/52/EU and Article 5, relating to the preparation of an EIAR by the developer, was amended to state the following should be included regarding alternatives:

"...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)(d)).

This is further reinforced in Annex IV the Revised EIA Directive (Information Referred to in Article 5(1) (Information for the EIAR) states that:

"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."

The Environmental Impact Assessment of Projects - Guidance on the preparation of the Environmental Impact Assessment Report (European Union, 2017) states that reasonable alternatives

"must be relevant to the proposed project and its specific characteristics, and resources should only be spent on assessing these alternatives" and that *"the selection of alternatives is limited in terms of feasibility. On the one hand, an alternative should not be ruled out simply because it would cause inconvenience or cost to the Developer. At the same time, if an alternative is very expensive or technically or legally difficult, it would be unreasonable to consider it to be a feasible alternative"*[1].

In addition as noted in the Draft Guidelines on the Information to be Contained in EIARs (August 2017) "*Analysis of high-level or sectoral strategic alternatives cannot reasonably be expected within a project level EIAR"* and *"that the amended Directive refers to 'reasonable alternatives... which are relevant to the proposed project and its specific characteristics'.*[2]*"*

[1] https://ec.europa.eu/environment/eia/pdf/EIA_guidance_EIA_report_final.pdf

[2] https://www.epa.ie/pubs/advice/ea/EPA%20EIAR%20Guidelines.pdf

The Environmental Protection Agency (EPA) in its 2017 draft guidance on EIAR preparation stipulates in Section 3.4 (consideration of alternatives) that '*The presentation and consideration of the various alternatives investigated by the applicant is an important requirement of the EIA process'.*

The alternatives may include:

- Alternative locations;
- Alternative designs; and
- Alternative processes.

The following text provides information on the consideration of alternatives, including 'do nothing' (Section 3.3.1), alternative locations (Section 3.3.2), alternative design and layout, (Section 3.3.4), and alternative processes (Section 3.3.5). Alternative mitigation measures are considered where appropriate in the EIAR technical chapters.

3.2 METHODOLOGY

3.2.1 Standards and Guidance Documents

The following documents and guidance were reviewed in the preparation of this chapter:

- Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA, 2017);
- Environmental Impact Assessment of Projects - Guidance on the preparation of the Environmental Impact Assessment Report (European Union, 2017);
- Transposition of 2014 EIA Directive (2014/52/EU) in the Land Use Planning and EPA Licencing Systems (DoHPCLG, 2017);
- Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment; and
- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (Department of Housing, Planning and Local Government, 2018).

Consideration was also given to the following as part of the literature review:

- Draft Advice Notes for Preparing Environmental Impact Statements (EPA, 2015);
- Advice Notes on Current Practice (in the preparation of Environmental Impact Statements) (EPA, 2003); and
- Guidelines on the information to be contained in Environmental Impact Statements (EPA, 2002).

3.3 CONSIDERATION OF ALTERNATIVES

In accordance with Directive 2011/92/EU as amended by Directive 2014/52/EU and taking into account the above standards and guidance documents listed, including the draft guidelines on the information to be contained in EIAR (EPA 2017) this chapter addresses alternatives under the following headings:

- 'Do Nothing' Option;
- Alternative Locations;
- Alternative Layouts;
- Alternative Design;

- Alternative Processes;
- Alternative Mitigation Measures.

Each of these is addressed in the following sections. When considering a wind farm development, given the intrinsic link between layout and design, the two will be considered together in this chapter.

3.3.1 'Do-Nothing' Option

The "Do-Nothing" scenario is not to develop the proposed project and to leave the existing environment as it is, with no changes made to the current land-use practices. In such a scenario, the prospect of capturing valuable renewable energy resources would be lost. The opportunity to contribute to meeting Government and EU targets to produce electricity from renewable resources and the reduction of greenhouse gas emissions would also be lost. Furthermore, the chance to generate additional local employment and investment would not occur, the local economy would remain less diverse, and continue to rely primarily on agriculture and forestry as its main source of income.

In accordance with the EU Directive on the Promotion of the Use of Renewable Energy (2009/28/EC), enacted in Ireland (S.I. No. 147/2011 - European Communities (Renewable Energy) Regulations 2011), Ireland has committed to ensuring that 16% of the total energy consumed in heating, electricity and transport is generated from renewable resources by 2020 to reduce the nation's CO_2 emissions and to promote the use of indigenous sources of energy. Under the 'Do-Nothing scenario', there will be no opportunity to provide additional renewable energy into the electricity grid.

Under Section 7.2 of the 2019 Climate Action Plan, which is discussed further in Chapter 4 of this EIAR (Policy Planning and Development), the following targets have been set out:

- Reduce CO_2 equivalent emissions from the electricity sector by 50–55% relative to 2030 pre-National Development Plan projections;
- Deliver an early and complete phase-out of coal- and peat-fired electricity generation;
- Increase electricity generated from renewable sources to 70%, indicatively comprised of:
  - at least 3.5 GW of offshore renewable energy;
  - up to 1.5 GW of grid-scale solar energy; and
  - up to 8.2 GW total of increased **onshore** wind capacity.

Under the "Do-Nothing" scenario, the Castlebanny Wind Farm project would not go ahead, the development of wind turbines would not be pursued, and all lands associated with the proposed project would remain in their current uses (primarily forestry and agriculture). The prospect of creating sustainable energy would be lost at this site. The nation's ability to produce sustainable energy and reduce greenhouse gas emissions to meet EU targets and targets set out in the Climate Action Plan (2019) would be reduced.

The proposed development is estimated to offset 111,125 tonnes of CO_2 emissions per year, which would otherwise be released to the atmosphere through the burning of fossil fuels in the "Do-Nothing" scenario. Importation and use of fossil fuels would continue and Ireland's energy security would remain vulnerable. According to EirGrid Group's All-island Generation Capacity Statement 2018 – 2027, the growth in energy demand for the next ten years will be between

15% and 47%[3]. Under the 'Do-Nothing' scenario, the socio-economic benefits associated with the proposed development will be lost. These benefits include up to 100 no. jobs during the construction phase of the project, and up to 3-4 long term jobs once operational.

In implementing the 'Do-Nothing' alternative, the opportunity to capture a significant part of this location's renewable energy resource would be lost, as would be the opportunity to contribute to meeting Government and EU targets for the production and consumption of electricity from renewable resources and the reduction of greenhouse gas emissions. The opportunity to generate local employment,–rates, and investment in the local community in terms of community benefit funds would also be lost.

Table 3-1: Environmental Impacts of the Do-Nothing Alternative relative to the Chosen Option

Environmental Consideration	Do Nothing Alternative
Human Health and Population	No increase in employment as a result of the development No long-term investment in sustainability in the locality No long-term development of a recreational facility locally.
Biodiversity	Forestry would continue to be clearfelled as part of the ongoing forestry growth cycle. No potential for construction/operation phase impacts.
Land, Soils and Geology	Forestry works will be carried out as required. No potential for construction phase impacts.
Hydrology and Hydrogeology	Forestry works will be carried out as required. No potential for construction phase impacts.
Shadow Flicker	No potential for shadow flicker, however, the developer has committed to zero shadow flicker.
Material Assets – Telecommunications & Aviation	Neutral - No potential for impacts on telecommunication links and flight activity. However the developer has avoided impacts on telecommunications and flight activity.
Air Quality and Climate	Missed opportunity to contribute to the reduction of carbon and greenhouse gas emissions.
Noise and Vibration	No potential for additional noise nearby sensitive receptors
Cultural Heritage	No potential impacts on archaeology or local cultural heritage
Landscape and Visual Impact	Existing landscape and visual amenity in the area will remain unchanged.
Traffic	No potential increased traffic volumes on local roads

[3] http://www.EirGridgroup.com/site-files/library/EirGrid/Generation_Capacity_Statement_2018.pdf

	No works required in other areas for turbine delivery

3.3.2 Alternative Site Selection

The site selection process for the proposed development initially began in 2014, Coillte's Renewable Energy Development Team undertook a detailed screening process, through Geographical Information Spatial software (GIS), using a number of criteria and stages to assess the potential of a large number of possible sites, on lands within its stewardship (c. 441,000 hectares), suitable to accommodate a wind energy development. The GIS database drew upon a wide array of key spatial datasets such as forestry data, ordnance survey land data, house location data, transport, existing wind energy and grid infrastructure data and environmental data such as ecological designations, landscape designations and wind energy strategy designations available at the time. During the initial screening stage, the site selection process discounted lands that were not available for development under a number of criteria, as follows:

- Committed Lands for other developments;
- Millennium Sites (This is a Coillte environmental designation – these sites were planted and managed for provision of a tree for every household in the country as part of the Millennium tree planting project);
- Life Site (This is a Coillte environmental designation – these former forested sites were cleared and are managed for biodiversity);
- Wild Nephin Properties (This is a Coillte designation. Since 2014 these properties have been incorporated into National Parks);
- Farm Partnerships and Leased Lands;
- National Parks;
- Natura 2000 and Nationally Designated Sites (SAC, SPA, NHA, pNHA)

Areas throughout the country where wind energy developments already exist were examined to determine and locate areas with capacity for future wind energy development, as well as areas with cumulative capacity to absorb further wind energy development. Figure 3-1 shows the locations of existing wind energy projects as of 2019 on the island of Ireland.

EirGrid's All-Island Ten-Year Transmission Forecast Statement 2017[4] states that the electricity transmission system is the backbone of the power system, efficiently delivering large amounts of power from where it is generated to where it is needed. An assessment of Grid Capacity across the country identifies the existing infrastructure throughout the country. Figure 3-1: Existing Wind Energy Development in Ireland below shows the transmission system which is more extensive at towns and cities with strategic cross-country connections in between. The site selection process for the Castlebanny Wind Farm considered proximity to grid infrastructure as an important factor due to the requirement of returning the electricity to the national grid in a sustainable and efficient manner.

[4] http://www.EirGridgroup.com/site-files/library/EirGrid/TYTFS-2017-Final.pdf

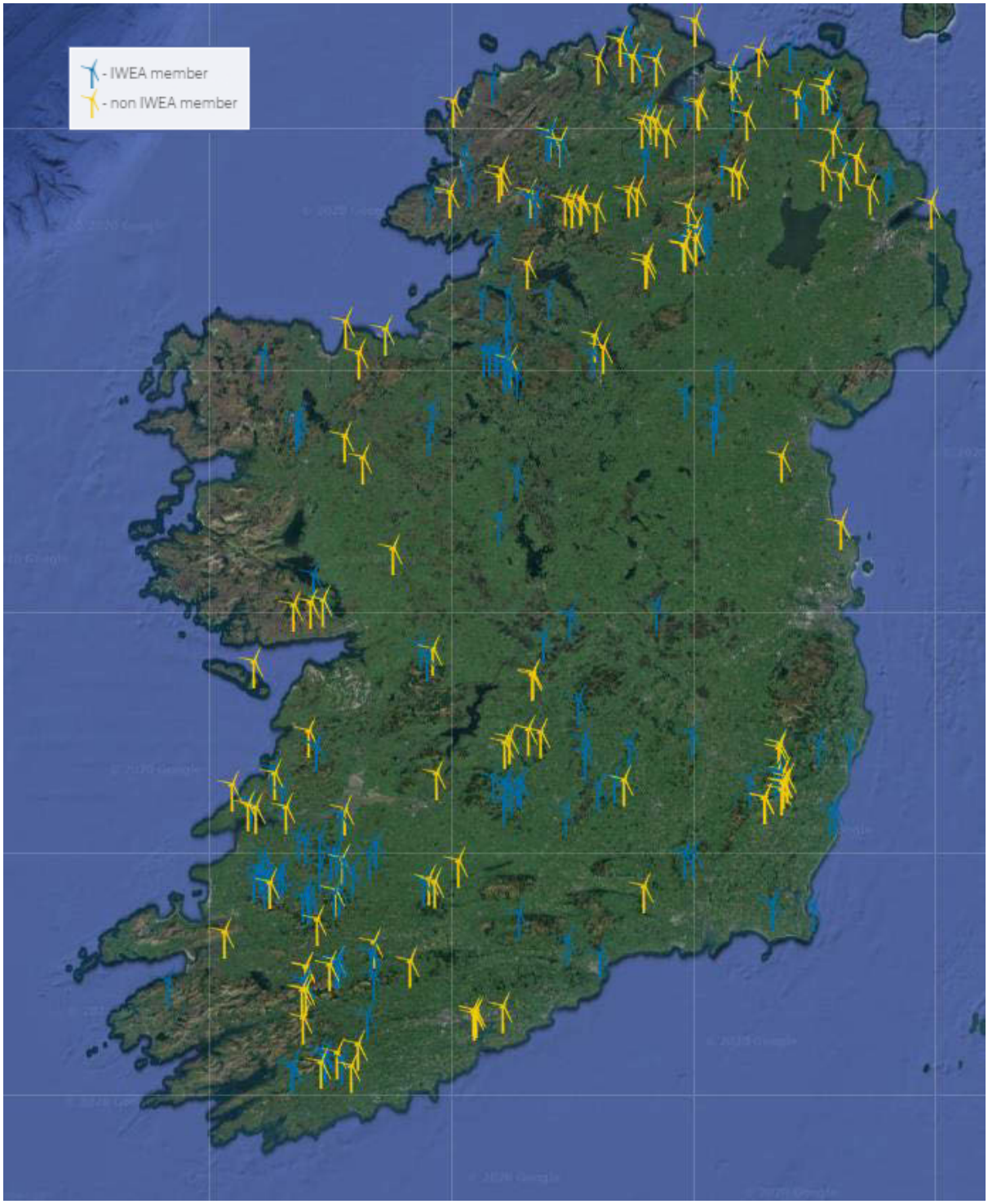


Figure 3-1: Existing Wind Energy Development in Ireland[5]

[5] https://www.iwea.com/about-wind/interactve-map

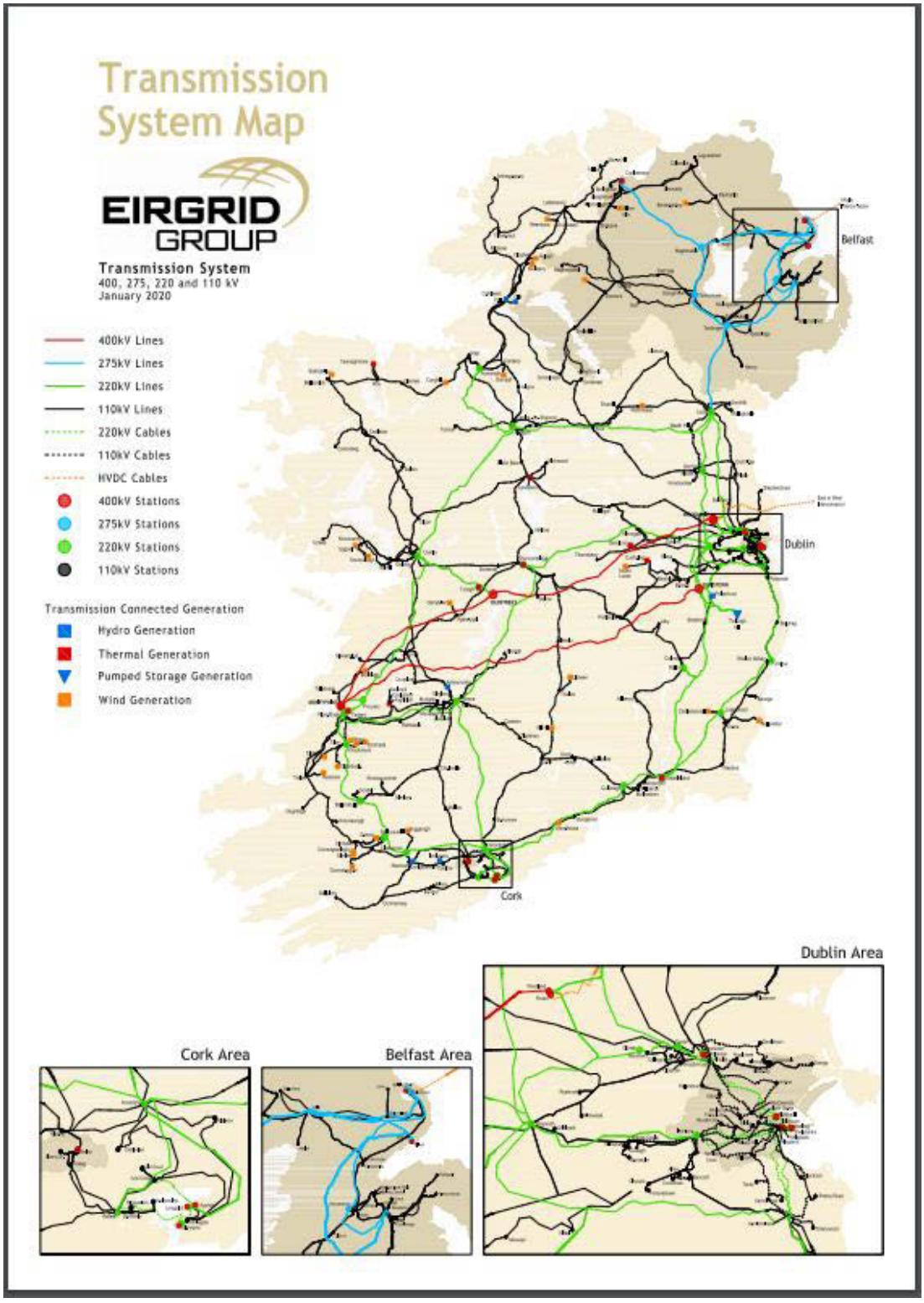


Figure 3-2: National Transmission System6

[6] http://www.EirGridgroup.com/site-files/library/EirGrid/EirGrid-Group-Transmission-Map-January-2020.pdf

The next stage of screening out lands from further analysis was due to the presence of the following:

- Sensitive Amenity or Scenic Areas designation in CDPs;
- Tourist areas/sites/trails;
- Lands utilised for other wind farm developments;
- Telecommunications masts and links;
- Sensitive habitat/species of bird;
- Land Ownership title Issues;
- Relatively high residential density in vicinity;
- Unfavourable slopes and ground conditions.

The application of the above to identify a site most suitable for wind energy and its specific characteristics, resulted in the selection of the proposed site in Castlebanny.

Other sites that also emerged from the site selection process for which Coillte are progressing separate planning applications are:

- Croagh, Co. Sligo
- Carrownagowan, Co. Clare
- Glenard, Co. Donegal
- Bottlehill, Co. Cork

Coillte intend to bring forward all of these landholdings for wind energy development as all were considered by Coillte to be viable sites for a wind energy project. Each are projects in their own right which 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.

The alternative would be to bring forward a site that did not pass the above screening process. In that instance, there would be the potential for the construction and operation of a wind energy development to have an adverse effect on ecologically designated or sensitive areas and visually sensitive (scenic) or amenity areas. There would also be the potential for greater shadow flicker, noise and traffic impacts if the candidate site was located in an area with a higher number of residential dwellings. Numerous third-party land agreements would also be required to ensure a site of adequate size. In addition, a site with an average wind speed less than 7m/s (at 80m above ground level) and/or not located within practical proximity of existing grid infrastructure may not be economically viable.

ART Generation had identified that the southeast region of Ireland had available grid capacity and subsequently a number of alternative sites were studied in Counties Kilkenny and Tipperary. The assessment carried out was a two-stage process. The first stage comprised the identification of a number of candidate sites while the second phase comprised a site-specific assessment. The site assessments were carried out by a consultant team with inputs from competent experts on ecology, landscape and visual considerations, archaeology as well as technical and engineering considerations.

Although a number of alternative sites for wind energy development were assessed, the following sites were studied in greater detail:

Kilnagranagh, Cloneen, Fethard, County Tipperary

The site located within the townland of Kilnagranagh is designated as 'Open to Consideration' in the South County Tipperary Development Plan 2009 (as varied). The site had potential for an output of approximately 30MW and had a number of positive attributes as a potential wind farm location. However, there were concerns relating to the visual impact of the potential farm following landscape feasibility studies. Good setback distances were achievable from dwellings and the site consisted of a highly modified habitat of low conservation value.

However, there were a number of difficulties encountered with the site which included;

- Visual impact on the landscape
- Poor Access to the site
- Technical difficulties with the grid connection point with the national electrical grid

The Devilsbit, Co. Tipperary

The site is situated in an upland area in North Tipperary. The site is located adjacent to an existing windfarm and had the potential for approximately 20MW. Good setback distances were achievable from dwellings and the site consisted of a highly modified habitat of low conservation value. However, there were a number of fundamental issues with the site and it was discounted for the following reasons:

- The site is designated as 'Unsuitable for New Wind Energy Development' in The Tipperary Renewable Energy Strategy.
- The site has a high landscape sensitivity. The Landscape Character Assessment of Tipperary sets out classified landscape character areas, based on a qualitative assessment of their landscape value, into 6 classes of sensitivity to development: ranging from "Robust" to "Vulnerable" The site is located in an area designated as "Vulnerable" in The Tipperary Renewable Energy Strategy.

Firoda Upper and Skehana, Castlecomer Co. Kilkenny

The site is situated in a rural setting with relatively low housing density, and the land use is predominantly coniferous forestry. The Site had the potential for approximately 40MW. There were a number of difficulties encountered with the site which included:

- Proximity to dwellings [difficulty in achieving setback distances from dwellings]
- Technical difficulties with the grid connection point with the national electrical grid
- Poor Access to the site

Coan East, Castlecomer Co. Kilkenny

The Site has two pockets designated as 'Preferred' in the Kilkenny County Development Plan 2014-2020. The site is situated in a rural setting and housing density in the vicinity of the site is relatively low. This site had the potential for approximately 30MW. However, the site had a number of negative attributes which made it unsuitable for wind energy development, mainly the proximity to dwellings [difficulty in achieving setback distances from dwellings].

Castlebanny, Co Kilkenny

Following the studies of alternative sites the subject site was considered the most suitable having regard to landscape designation; environmental considerations; planning policy considerations; setback distance to dwellings, road access and proximity to the national grid.

3.3.3 Combined Site Selection

Following the separate site selection processes undertaken by Coillte and ART Generation and the commencement of separate and overlapping site surveys in the Castlebanny area, both parties agreed to share resources to develop the site together. The separate identification and initial development of the proposed project site reinforces the suitability of the site location for a wind energy development.

3.3.3.1 Selection of Candidate Site

Following the initial selection of the proposed site in Castlebanny, further detailed assessment was undertaken to confirm the suitability of the site. The proposed site was examined under the following headings:

- Wind resource / speed in the area;
- Proximity to the National Grid;
- Planning policy, designations, zoning;
- Environmental designations (avoidance of Natura 2000 sites and other nationally designated sites);
- Accessibility, and road network;
- Distance from settlements and residential properties;
- Visual and Landscape Impact and
- Telecommunication, Archaeological, Geotechnical and Hydrological constraints.

The site selection process took as its starting point the areas that had been identified in the current Kilkenny County Development Plan 2014-2020 (CDP) as suitable for Wind Energy Developments. A Wind Energy Strategy was developed by CAAS (Environmental Services) Ltd. in 2003, which was revised as part of the 2014-2020 Development Plan. As per section 10.5.3 of the CDP - Development Management Guidelines, all Wind Farm applications must be assessed in accordance with the Wind Energy Guidelines[7]. As discussed in detail in Chapter 4 of this EIAR, Planning, Policy and Development Context, the proposed site is located in an area identified as 'Area 18-Open for Consideration' for wind farm developments. It states that "*this area has some heritage considerations but due to its location at a remove from centres of large populations, windfarm developments may be acceptable*"[8]. As stated in Section 10.5.4 of the CDP, wind farm projects in areas designated as 'Open for Consideration' will be considered if they comprise no more than 5 turbines, where the total output is not greater than 5 Megawatts and where turbine heights do not exceed 65m in height.

When the proposed project was weighed against key criteria set out in the Wind Energy Development Strategy, Appendix J of the CDP (Settings/backdrops, Tourism/Heritage and Existing wind farms), given the detail of the project available to the project developers and preparation of Zone of Theoretical Visibility maps, it was considered that the outcome of the wind energy strategy in respect of this area would have been 'Preferred' for the proposed project. This is discussed further in Chapter 4 Policy, Planning and Development Context.

Having looked at the potential zoned areas in terms of wind speed, density of housing, sensitive landscapes, proximity to designated sites, etc. the current area was further investigated. The

[7] https://www.housing.gov.ie/sites/default/files/migratedfiles/en/Publications/DevelopmentandHousing/Planning/FileDownLoad%2C1633%2Cen.pdf

[8] https://www.kilkennycoco.ie/eng/Services/Planning/Development-Plans/Development_Plans_2014-2020/County-Appendices-for-printing.pdf

available wind resource and the proximity of the subject site to the existing infrastructure of the National Grid was a key driver on the final selection of the site. The site proposed for the Castlebanny Wind Farm Development emerged as an optimal location for a wind energy development. A summary of its findings is provided in Table 3-2 below.

Table 3-2: Summary of the key findings with respect to the site chosen for the proposed development site

Criterion	Proposed Development Site
Grid Access/Capacity	The proposed development site was determined to be well-placed in terms of proximity to existing grid infrastructure and in terms of available grid capacity at the relevant nodes. The proposed development will include an onsite 110kV substation with loop in underground grid connection to the existing 110kV overhead line in Ballyvool.
County Development Plans and Zoning	The proposed development complies with the policies of the Regional Planning Guidelines and the current Kilkenny County Development Plan. As per Appendix J of CDP 'Wind Energy Strategy' the site is located in an area designated as "Open for Consideration" in the Wind Energy Development Strategy prepared for the county. As discussed in further detail in Chapter 4 of this EIAR, Planning, Policy and Development Context, 'Open for Consideration' designations states that "this area has some heritage considerations but due to its location at a remove from centers of large populations, windfarms developments may be acceptable"
Proximity to Houses	In general, the site is surrounded by a mixture of forestry and agricultural land. The landscape is gently sloping. Given the extent of the lands it was considered that the setback distance requirements of 500m (as stated in the current Wind Energy Guidelines 2006), could easily be met at this location. The nearest dwellings are more than 4 x tip height from the proposed turbine locations which is also in compliance with the Draft Revised Wind Energy Development Guidelines 2019.
Wind Resource Assessment	The Wind Atlas mean wind speed was determined for this site and the wind speed for the proposed development site was considered to be suitable in the context of operational efficiency and the nature of modern-day turbine technology. The 2013 SEAI Wind Speed Atlas identifies the site as having a wind speed of between 8 m/s and 9 m/s at 100m above ground level, identifying the site as a candidate for wind energy.
Environmental Sensitivity	There are no NHAs or pNHAs in or adjacent to the proposed wind farm site. In addition, there are no NHAs within 15 km of the proposed wind farm site. Furthermore, there are no sites designated under the EU Habitats Directive (SACs) and EU Birds Directive (SPAs) located within the footprint of the proposed development, however, the grid connection route is proposed to cross the River Arrigle, which is part of the River Barrow and River Nore SAC. There will be no direct impact on the watercourse or any habitats within this SAC, as it is proposed to directional drill under this area. There are three other SACs within 15 km of the proposed wind farm site which include: • Hugginstown Fen SAC • Thomastown Quarry SAC • Lower River Suir SAC Finally, there is one SPA within 15km, the River Nore SPA which encompasses the main channel of the Nore to the north of the site.
Landscape Capacity/ Cumulative Impact	For the site itself the significance of landscape impact is deemed to be Substantial-moderate, whilst for the central study area the significance of

Criterion	Proposed Development Site
	landscape impact is judged to be Moderate. As discussed in Chapter 4 Policy Planning and Development Context there are two commissioned wind farms to the south and south east of the site namely; Ballymartin Wind Farm and Rahora Wind Farm, respectively (as shown in Figure 14-23 of Chapter 13 in this EIAR, Landscape and Visual Impact). In addition, the Great Island to Kilkenny 110kV line is located a short distance from the site. However, as concluded in Chapter 14 (Landscape and Visual Impact), the magnitude of cumulative effects in respect of other wind farms is deemed to be Low.
Aviation	As discussed in detail in Chapter 11 (Material Assets: Telecommunication & Aviation) following consultation with relevant stakeholders in the aviation sector, a number of potential areas of impacts were identified. However, no significant aviation impacts were identified at site selection stage and the proposed development is not anticipated to have any significant impacts.
Land Use	The land use/activities on the site are primarily commercial forestry, with some areas of pastoral agriculture. The surrounding landscape is a mixture of agricultural land and forestry. The landscape is predominately undulating in the wider area, with the site of the proposed wind farm itself being located on an elevated area with a topography of between 145m and 265mOD. The most significant features in the surrounding landscape are the River Arrigle valley which is 1.1km to the east, and the upland areas containing the proposed wind farm and to the east towards Inistioge. The primary current land uses are of commercial forestry and agriculture. Areas of forestry will be clear-felled at some point in the future as part of the ongoing forestry growth cycle, while agricultural areas are subject to intensive management Based on the above, the land use at the site was found to be compatible with a wind farm installation
Communications Infrastructure	The site was found not to be heavily constrained by existing communication links, and therefore the site design was able to account for these links to ensure it avoided any impacts. Further information on telecommunication links is provided in Chapter 11 (Material Assets: Telecommunications and Aviation).
Flood Plain Analysis	There is no record of pluvial flooding or surface water ponding at the proposed wind farm site that would prohibit the development of the proposed project. Surface water arising at developed areas of the site will be managed by a dedicated stormwater drainage system designed in accordance with Sustainable Drainage Systems (SuDS) principles, limiting discharge from the site to greenfield runoff rates. While the R704 at the River Arrigle and local roads at Ballyhale and Knockwilliam are known to flood after heavy rainfall, there are no OPW records of past flooding within 1.5 km of the proposed wind farm site.
Supporting transport Infrastructure	The transport infrastructure in the surrounding area is deemed to be sufficient to accommodate the proposed wind farm project. The proposed development site will be accessed via the R704 regional road, which itself has direct access to the M9 Motorway. This entrance from the R704 will be the main construction ~~and operations~~ entrance to the site. It will facilitate material deliveries to the site (stone, steel, and concrete) and staff access, as well as large oversize components such as turbine blades, tower sections and substation components. The proposed site entrance on the L7451 will be used for the operational phase, facilitating occasional site maintenance vehicles, as well as those using the proposed recreational amenity. Internal access

Criterion	Proposed Development Site
	roads will be constructed as part of the initial phase of the construction of the wind farm.

3.3.4 Alternative Layouts / Designs

During the EIAR assessment stage, environmental surveys of the site of the proposed project were carried out to establish the baseline environment. All site constraints were identified and updated as further detailed assessment was undertaken. The locations of county roads, streams, residential dwellings, landowner boundaries, telecommunication links, ecologically sensitive areas, archaeological sites and visually sensitive areas were noted. Separation distances to identified constraints were determined using a Geographical Information System (GIS) (See Figure 3-1 for the Castlebanny Wind Farm Constraints Map).

The site layout design stage considered the size, number and positioning of turbines and layout of associated site infrastructure i.e. internal access tracks, temporary construction compounds, met masts, substations, etc. Alternatives considered for each of these elements are documented in the following sections. It was an iterative process comprising input from the design team, environmental specialists, internal and external stakeholders. As an iterative process, environmental effects were reduced or eliminated through changes to the design, where possible. The constraints which were identified are provided as Figure 3-1.

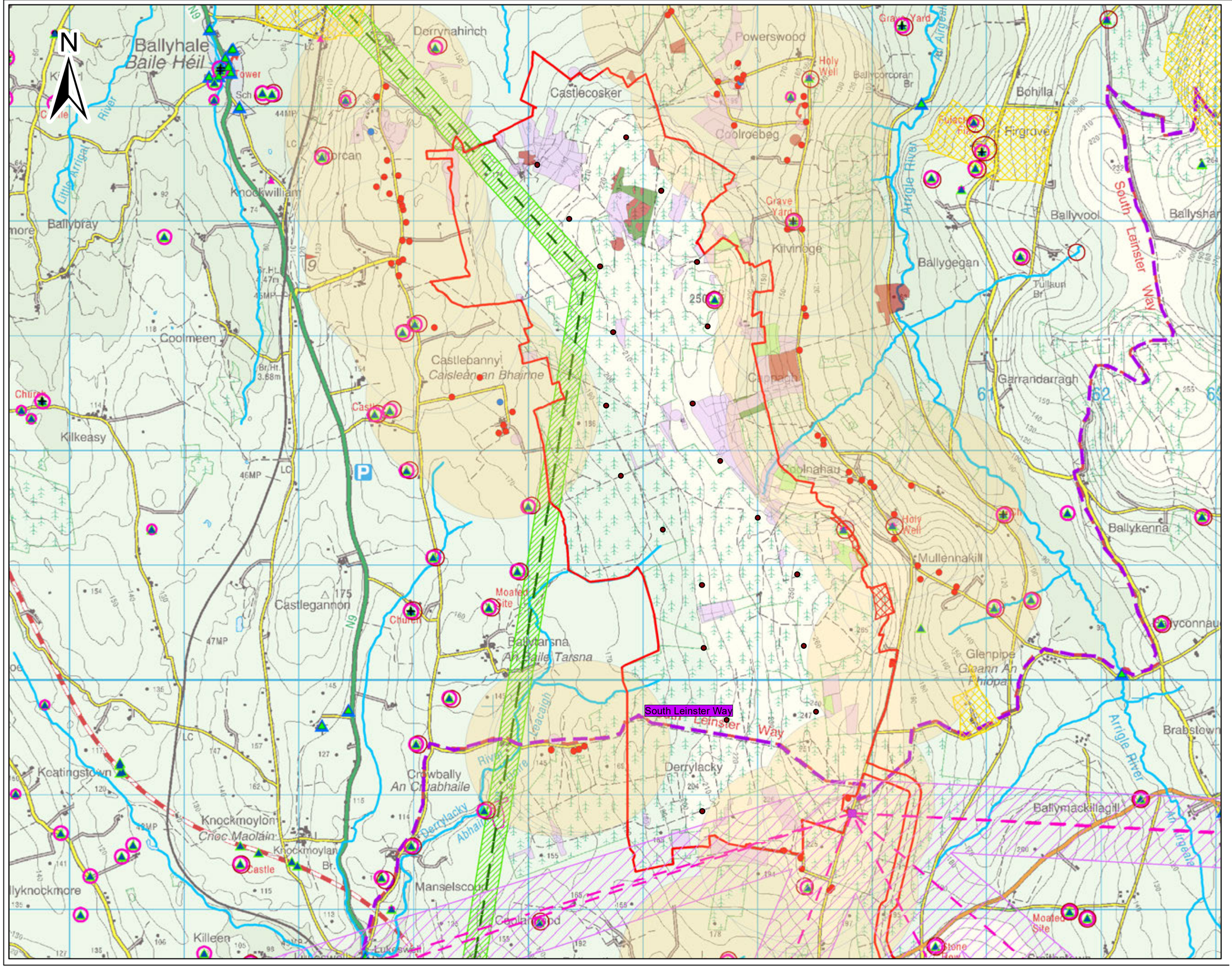
Constraints and environmental sensitivities were first identified, and buffers applied in order to determine a viable area within the site to accommodate development. The constraints identified and resulting design solutions are listed in Table 3-3 below.

Table 3-3: Environmental Considerations.

Environmental Consideration	Required Setback/Constraint	Design solutions
Residential Amenity	The existing 2006 Wind Energy Development Guidelines do not have a prescribed minimum setback but indicate that a 500m setback distance should be sufficient.	In order to minimise potential noise effects and impacts on residential amenity, it was decided early in the design process that a set-back of 750 m would be appropriate. A final minimum setback of >750 m has been achieved. This is more than 4x times the tip height (in this case 740 m), which complies with the current 2006 Wind Energy Development Guidelines as well as the 2019 Draft Revised Wind Energy Development Guidelines.
Flora and Fauna	Mitigatory measures designed to avoid potential impacts on species and habitats.	The potential effects on Flora and Fauna as outlined in Chapter 6 Biodiversity shows that the proposed development will have no significant effect on most ecological features. As a result of the current land use for commercial forestry, significant flora and fauna at the site is limited. Consideration has been given to identify sensitive areas on the site and these areas will be avoided. In addition, a program of habitat restoration and enhancement is envisaged, especially considering the intensity of land use in the study area and surrounding landscape.

Environmental Consideration	Required Setback/Constraint	Design solutions
Ornithology	Avoidance of nesting area, foraging sites and migratory routes.	As per Chapter 7 - Ornithology mitigation measures were designed to reduce any impacts to bird populations. The following additional specific measures will be implemented to mitigate impacts to bird populations: • Tree felling and scrub clearance will not be carried out during the bird breeding season (1st March - 31st of August). • Based on the results of the pre-construction / construction breeding bird surveys, construction work will be timed to avoid work in close proximity to any breeding Snipe locations within the wind farm site during the Snipe breeding season. • Subject to the findings of the pre-construction bird surveys, construction work along the section of the grid connection route that crosses the Arrigle River will not be carried out during the Snipe breeding season to avoid disturbance to any breeding Snipe in this area. • Brash will be removed from the felled areas close to turbines to discourage Hen Harrier or other birds of prey from foraging and nesting in these areas. • The CEMP will include specific noise limits and noise control measures to mitigate potential disturbance impacts to birds.
Soils and Geology	Avoid areas o peat.	The proposed site is not a sensitive site in terms of soils and geological environment, due to commercial forestry and the sites low geological value. No additional design solutions were needed. There was only evidence of small and shallow pockets of peat found within the site boundary. The proposed infrastructure was designed to avoid any such areas of peat on site.
Hydrology	Avoid impact on drainage regime.	In identifying and avoiding direct impacts on drainage features the proposed development has implemented 'avoidance of impact' measures. Examples include bottomless culverts or clear span structures for all drainage crossings and replicating drainage width, side slopes and substrate in proposed drainage channels where existing drains needs to be rerouted.
Water Quality	Minimum setback from significant rivers and streams and appropriate mitigation designed to avoid siltation during construction.	There will be 4 no. watercourse crossings along the grid connection route. Directional drilling is the preferred option for 2 no. of identified river crossings, at the River Arrigle and one of its tributaries, while the remaining two crossings will avoid in-stream works. 50m setback from turbines and roads will be maintained as practicable.

Environmental Consideration	Required Setback/Constraint	Design solutions
		Before any ground works are undertaken, double silt fencing will be placed upslope of the watercourse channel along the 50m buffer zone boundary
Noise and Vibration	The 2006 wind Energy guidelines states that 'a lower fixed limit of 45dB(A) or a maximum increase of 5dB(A) above background noise at nearby noise sensitive locations is considered appropriate to provide protection to wind energy development neighbours.' Similarly, these guidelines indicate "*A fixed limit of 43dB(A) will protect sleep inside properties during the night*."	As stated above a 750 m minimum setback from nearby dwellings has been achieved. The appropriate day and night noise limits will be adhered to by the proposed development, as described in Chapter 12 (Noise & Vibration).
Shadow Flicker	Zero shadow flicker.	The proposed project has committed to Zero shadow flicker. This is compliant with the 2006 Wind Energy Guidelines and is in line with both the emerging best practice and the Draft Wind Energy Guidelines 2019. This is described in further detail in Chapter 10 (Shadow Flicker).
Cultural Heritage	No direct impact on recorded archaeological monuments or architectural sites.	The final layout has been designed to ensure that there is no direct impact on recorded archaeological monuments or architectural sites.
Material Assets	No significant impacts to any telecommunications networks or aviation in the area.	The final layout has been designed to ensure that there is no direct impact on telecommunication links. It has also been found that the proposed project will have no significant impact on aviation related activities.



Legend

- Site Boundary
- Turbine Locations
- 750m Buffer from Buildings in Proximity

General Constraints

Buildings in Proximity

- C - Commercial Building
- R - Residential Building
- Religious Site
- ArchaeologicalMonument
- National_Monument_in_State_Care-point
- National Inventory of Architectural Heritage
- Protected Structure
- Sites and Monuments Record Zone
- Record of Monuments and Places - Zone of Notification
- Demesne Landscape or Historic Garden
- South Leinster Way
- ESB Point to Multipoint Radio Highsite
- ESB Microwave Links
- ESB Microwave Links 295m Buffer
- EIR Transmission Links
- EIR Transmission Links 100m Buffer

Ecological Constraints

High Level Environmental Constraints

- Ecologically High Constraint
- Ecologically High Opportunity
- Ecologically Moderate Constraint
- Ecologically Moderate Opportunity
- Sites and Monuments Record Zone
- Rivers
- Castlebanny_BioClassAreas
- CastlebannyOldWoodland

Setback from Residential Properties
(Coillte Standard 750m Setback Distance)

Issue	Date	Description	By	Chkd.
A	Dec. '20	First Issue	N.O.C.	R.H.

0 0.5 1
Kilometres

Client: COILLTE

Project: Castlebanny Wind Farm

Title: Constraints Map

Scale @ A3: 1:30,000

Prepared by:	Checked:	Date:
N.O'Connell	R. Hunt	Dec 2020

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Drawing No.: Figure 3-3

Draft: A

Within the viable area which emerged from the above constraint's analysis 3 main alternative design options were considered during the design stage. These alternative designs are illustrated in Figure 3-4.

The location of individual turbines is influenced by a range of design constraints. As information regarding the proposed site was compiled and assessed, the number of turbines, size and location of turbines were revised and amended to take account of the physical constraints of the site and the requirement for buffer zones and other areas which were not favourable for turbine locations for reasons such as visual constraints, noise constraints, ecological constraints, etc.

The proposed wind turbine layout has been optimised using appropriate wind farm design software to optimise the energy yield from the site, while maintaining sufficient distances between the proposed turbines to ensure turbulence and wake effects do not compromise turbine performance. Development of the final proposed wind farm layout has resulted from feedback from assessments carried out during preparation of this EIAR, and information supplied from consultation.

As previously mentioned consideration was also given to relevant guidance, namely the current Wind Energy Development Guidelines 2006, Best Practice Guidelines for the Irish Wind Energy Industry (IWEA, 2012); Draft Guidelines on the information to be contained in Environmental Impact Assessment Reports (EPA, 2017) and guidelines and recommendations from the relevant local authority's county development plans and wind energy strategies. Cognisance was also taken of the Draft Revised Wind Energy Guidelines (Draft Revised Guidelines), (DoEHLG, 2019) in particular with regards to setback distances to dwellings.

The initial constraints study identified a significant viable area within the proposed development site (Figure 3-4 Site Layout Design History Map), in which potential turbine layouts were developed. These turbine layouts were then refined a number of times following feedback from the project team during detailed site investigations and from consultees. At the initial stage, a project design was drafted which would maximise the wind energy potential of the site.

The resulting draft layout consisted of 33 no. turbines with initial distances to houses of 750m. This layout was based on turbine tip heights of 170m and rotor diameters of approximately 140m. This layout maximised the available area within the site whilst staying out of areas constrained for various reasons (telecommunications links, sensitive biodiversity areas, etc.).

An alternative layout informed by the same parameters but with turbine tip heights of 185m and rotor diameters of approximately 155m was also prepared. This layout had 25 turbines; the lesser number required for greater separation between the turbines to minimise wind wake effects.

The two layouts were the subject of a design review. This review was focussed on landscape and visual impacts. The review considered draft photomontages from a number of different locations including Jerpoint Abbey, Mount Juliet, Thomastown, Local Road at New Chapel, Mountain View Golf Course, R704 (South of the site) and the South Leinster Way. These locations were selected as a combination of the most sensitive views, population centres and fullest views of the project. The review concluded that the 25 turbines with greater tip heights was better from a landscape and visual impact perspective as it appeared less cluttered from the viewpoints with clear views of the turbines. It was also noted that even from closer views, there

was little obvious difference between the scale of the different turbine models. It was further noted that the 25 turbine layout was still somewhat cluttered and that a lesser number of

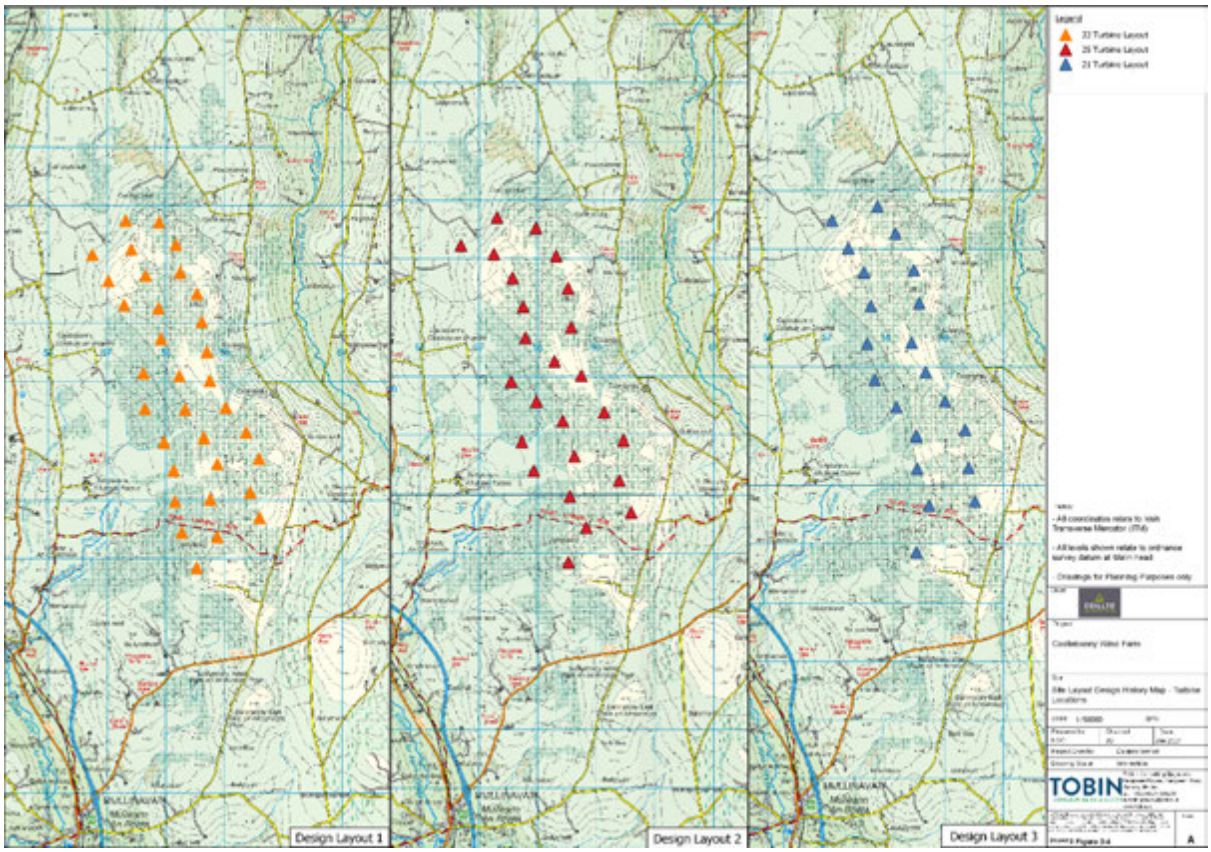

Figure 3-4 Site Layout Design History Map -Turbine Locations

turbines in two staggered lines would be optimal. This conclusion informed the next iteration of layout design.

The next iteration of the layout design took the recommendations from the layout review and developed two staggered lines of turbines of 185m tip height with a total of 21 turbines. This layout is very close to the final layout with some small adjustments.

A summary of the designs considered is set out in Table 3-4 below:

Table 3-4: Layout Design changes

	Initial 33 no. turbine Consideration	25 no. turbine Consideration	Current Design Proposal
Distance to houses	>750m	>750m	>750m
Shadow Flicker	none	none	none
No. of Turbines	33 no.	25 no.	21 no.
Turbine Height	170 m	185 m	185 m
Potential Output	Approximately 158 MW	Approximately 137.5 MW	Approximately 115 MW

The adjustments through each layout iteration resulted in placement changes to turbines to ensure sufficient distances were maintained from sensitive receptors and constraints, and to maintain the required separation distances between turbines. The potential environmental effects of the initial layout (33 no. turbines) and the second layout (25 no. turbines) when compared with the current proposed project are provided in Table 3-5 below.

Table 3-5: Table of environmental effects relative to proposed design layout of 21 no. turbines

Environmental Consideration	Initial Consideration – 33 turbines	Design iteration – 25 turbines
Human Health and Population	Potential for increased impact on sensitive receptors due to closer proximity to some turbines	Potential for increased impact on sensitive receptors due to closer proximity to some turbines
Biodiversity & Ornithology	Larger infrastructure footprint results in an increased potential for effects on habitats. Larger number of turbines leads to potential for increased impacts to bat and bird populations.	Larger infrastructure footprint results in an increased potential for effects on habitats. Larger number of turbines leads to potential for increased impacts to bat and bird populations.
Land, Soils and Geology	Higher number of turbines will give rise to more excavations and disturbance of soil onsite, in addition to requiring more crushed stone for construction. This would therefore have an increased impact.	Higher number of turbines will give rise to more excavations and disturbance of soil onsite, in addition to requiring more crushed stone for construction. This would therefore have an increased impact.
Hydrology and Hydrogeology	Higher number of turbines will give rise to more excavations and disturbance of soil onsite. This would therefore have an increased impact.	Higher number of turbines will give rise to more excavations and disturbance of soil onsite. This would therefore have an increased impact.
Shadow Flicker	No significant difference in impact as project has committed to achieving zero shadow flicker at sensitive receptors.	No significant difference in impact as project has committed to achieving zero shadow flicker at sensitive receptors.
Telecommunications & Aviation	Neutral	Neutral
Air and Climate	Depending on the turbine output, there is potential for greater contribution carbon reduction targets.	Depending on the turbine output, there is potential for greater contribution carbon reduction targets.
Landscape & Visual Impact	Larger number of smaller turbines resulted in a cluttered appearance.	This approach (i.e. fewer taller turbines) was preferred to the initial layout, but there was

	Increased impact compared to current proposal.	still some visual cluttering of the proposed turbines. Slightly increased impact compared to the current proposal.
Noise and Vibration	Some receptors would have slightly higher noise although all would be within recommended noise limits.	Some receptors would have slightly higher noise although all would be within recommended noise limits.
Cultural Heritage	Larger site footprint gives rise to a higher potential for negative impacts on archaeology although all known sites of interest would be avoided.	Larger site footprint gives rise to a higher potential for negative impacts on archaeology (but less than 33 turbine layout) although all known sites of interest would be avoided.
Traffic	Increased number of turbines will require more deliveries to site, increasing potential for traffic impacts.	Increased number of turbines will require more deliveries to site, slightly increasing potential for traffic impacts.

3.3.4.1 Port of Entry

The port of entry chosen for turbine delivery to this site is Belview Port (Port of Waterford), which minimises the distance and therefore the associated traffic and air quality impacts arising from the delivery. However, given the central location of the site, a number of reasonable alternatives are feasible, including Dublin, Cork and Foynes. The selection of any of these ports is less favourable due to some challenging pinch points on each (e.g. from Cork/Foynes, no easy connection from M8/M7 to M9 and from Dublin, no easy transition from M50 to M7), and the associated climatic effects of a longer delivery route to site.

3.3.4.2 Turbine Delivery Route

As discussed in Chapter 2 (Description) and viewed in Figure 2-3 of this EIAR, the proposed TDR runs from Belview Port along the N29, west onto the N25, turning back on N25 at Carrick Rd Roundabout, exiting N25 west onto the N9 then turning north onto the M9. At exit 11, Mullinavat, the turbine delivery vehicle will exit the motorway. The final leg of the TDR is along the R704 turning to the site at the upgraded existing forestry entrance. .

Given the proximity to the proposed development, and the relatively straight-forward access between the site and the M9 Motorway, it was determined that any delivery route for oversize loads would need to use the M9 to minimise the potential for impacts on smaller roads.

Alternative options considered were the use of Cork and Dublin Ports. It was found that the use of Dublin Port would likely require significant works at the M50/M7 interchange, and due to the impacts this would have on traffic at such a busy location, this was viewed as a least preferred option. The use of the Port of Cork/Foynes was also considered, but due to the lack of a clear connection between M7 and M9 interchange and between the M8 and M9, and the associated potential traffic impacts any significant improvements would cause, it was decided that these would also be less preferred option. All of these options (Dublin Port and Port of Cork/Foynes)

would involve a longer transport route along busy road networks, and therefore would have the potential to cause increased traffic impacts compared to the currently proposed option.

After leaving the M9 and turning onto the R704 to the south of the proposed wind farm site, there were two main options considered. The first was to turn north onto the L7451, which is relatively straight with smooth gradient, where it would enter the site via an existing site entrance there. This would be the shortest route. The second option was to remain on the R704 and turn onto the proposed site entrance at an existing entrance to forestry to bypass the L7451, only needing to cross this local road at a single point. The latter was chosen as the most suitable option due to the reduced potential for impact on local residents. The options are discussed in Table 3-6 below.

Table 3-6:Table of environmental effects relative to proposed TDR (from Bellview Port via the N25, N9, M9 and R704)

Environmental Considerations	Alternative A – Route from Dublin Port	Alternative B – Route from Port of Cork/Foynes	Alternative C – Site access along L7451
Human Health and Population	Potential to negatively impact residents near M1/M50/M7 and M9 where any works are required.	Potential to negatively impact residents on connections between M7/M8 and M9 where any works are required.	Potential to negatively impact local residents along the L7451.
Biodiversity	Neutral	Neutral	Neutral
Land, Soils and Geology	Neutral	Neutral	Neutral
Hydrology and Hydrogeology	Neutral	Neutral	Neutral
Climate and Air Quality	Longer haul route leading to greater potential for emissions.	Longer haul route leading to greater potential for emissions.	Neutral
Landscape & Visual	Neutral	Neutral	Neutral
Noise and Vibration	Neutral	Neutral	Potential greater impact along the L7451 during transportation
Cultural Heritage	Neutral	Neutral	Neutral
Traffic	Potential significant impact where works are required near Dublin City or on busy motorway intersections. Longer haul route leading to greater potential for impacts.	Potential significant impact where works are required on connections between M7/M8 and M9. Longer haul route leading to greater potential for impacts.	Potential greater impact along the L7451 during transportation

The current proposal minimises such impacts and involves the shortest route possible.

3.3.4.3 Site Entrances

The initial option looked to utilise the Glenville Road (L7451) to provide access to the site. This was deemed to be the shortest and most straightforward route to the site from the R704 using a relatively short section of local road that would require little improvement works. During initial consultation with the local community, the increased traffic on the L7451 was viewed as a point of concern for residents. The use of an existing forestry access road to bypass the L7451 (only requiring a single crossing point) was then investigated and was viewed as the preferred option to minimise traffic impacts on the local road. During further consultation, concerns about the proposed crossing point of the L7451 were raised by local residents, and so an amendment was made to move the L7451 crossing point further northward away from nearby properties. This reduces the potential for impacts to these residents.

The proposed upgraded site entrance for the proposed development is located along the R704 regional road. This entrance will be the main construction and operations entrance to the site. It will facilitate material deliveries to the site (stone, steel and concrete) and staff access, as well as large oversize components such as turbine blades, tower sections and substation components. Internal access roads will be constructed as part of the initial phase of the construction of the wind farm. The Entrance on the L7451 will only be used in the operational phase. The options are discussed in Table 3-7 below.

Table 3-7: Table of environmental effects relative to proposed site entrance

Environmental Considerations	Option A – existing forestry entrance on L7451	Option B – R704 via Coillte Access Road and L7451 crossing point at existing forestry entrance
Human Health and Population	Additional disturbance and nuisance to local residents due to traffic along the L7451.	Slight temporary disturbance and nuisance to residents adjacent to the L7451 crossing point due to construction traffic. No significant difference with impacts.
Biodiversity	Reduced project footprint due to reduced length of required site road. No significant impact difference due to presence of commercial forestry.	Neutral
Land, Soils and Geology	Reduced project footprint due to reduced length of required site road. No significant difference with impacts.	Neutral
Hydrology and Hydrogeology	Reduced project footprint due to reduced length of required site road. No significant difference with impacts.	Neutral
Climate and Air Quality	Neutral	Neutral
Landscape & Visual	Some reduced visual impact associated with no upgrade of existing site entrance on the	Neutral

	R704, but works required at L7451 road junction. No significant change in impact.	
Noise and Vibration	Increased potential for negative effects on sensitive receptors along the L7451	Increased potential for negative effects on sensitive receptors adjacent to the L7451 crossing point, due to construction traffic. No significant difference with impacts.
Cultural Heritage	Neutral	Neutral
Traffic	Potential to have negative effects on L7451 due to the use of the road by construction traffic.	Neutral

New roadways will have a running width of approximately 5 metres (5.5m including shoulders), with wider section at corners and on the approaches to turbine locations. The proposed new roadways incorporate passing bays to allow traffic to pass easily while traveling around the site.

Typical Road Construction Details are included in Appendix 2-1 (Detailed Drawings).

3.3.4.4 Substation Locations and Grid Connection

The initial screening process highlighted the nearby electrical grid infrastructure and the available capacity in the area.

Based on the scale of the proposed project, it was known that a 110 kV connection would be required to accommodate the likely output from the project. An assessment of the nearest 110 kV infrastructure identified two potential connection points, a 110 kV substation at Waterford City or a connection onto an existing 110 kV line which passes approximately 3.5 km to the east of the centre of the site. An environmental and economic assessment clearly indicated that a connection to the existing 110 kV line running to the east of the site would have a lot less environmental impacts and would be more economically advantageous.

Following this decision, further assessment was undertaken to identify the best means of connecting to the existing 110 kV line. The first consideration was whether there should be a new substation directly under the existing 110 kV line or whether there should be a loop-in connection from a new substation located within the wind farm site.

It was found that construction of a substation on the slopes of the hills to the east of the site (under the existing 110kV overhead line) would pose a greater potential for negative visual impact, particularly due to its location removed from the proposed wind farm development, and due to the more exposed views of the areas here, particularly from elevated sections of the Glenville road which runs along the eastern boundary of the proposed wind farm site. At the same time, consideration was also given to potential substation locations within the wind farm site. There were two locations identified within the central area of the wind farm, west of the ridge, that would be screened from views from the eastern hills and, as well as being screened by forestry to the west, there are no elevated roads to the west that would have clear views of such a structure. It was also assessed that a substation located within the forestry would have a low impact on biodiversity and would fit more naturally with the wind farm development rather than creating a separate structure separate from the wind farm. Based on all of the above, it was

therefore decided that a loop-in connection with a 110kV onsite substation was the preferred approach.

The deciding factors for the location of the onsite substation within the site related to visibility and the EirGrid requirement to have a certain setback (2 times tip height) from proposed turbine locations. Two initial locations considered for the on-site substation (Connection 1A and Connection 1B in Figure 3-5 below) were considered to be exposed to views from the elevated roads and properties on the eastern hills. This along with the setback requirement ruled out many parts of the site, with two locations west of the ridge being considered after this. The current proposed substation location lies centrally within the site whereas the potential alternative location is located further to the north within the wind farm site. Both locations are heavily screened by forestry. Both potential substation locations within the site also achieved the required distance from turbines in order to comply with EirGrid specifications and both were located adjacent to the proposed wind farm access roads.

Table 3-8: Table of environmental effects relative to proposed grid connection infrastructure

Environmental Considerations	Alternative connection via new 110kV substation at Ballyvool	Alternative location of onsite substation for 110kV loop-in connection
Human Health and Population	Located closer to residences and increased traffic outside of the main wind farm site will lead to additional disruption. Potential for greater impact on amenity value of the local area due to visibility of the substation at Ballyvool.	Neutral
Biodiversity	Larger works footprint at Ballyvool, leading to slightly greater potential for impact.	Slightly longer grid connection within the site, leading to potential for greater impacts. No significant increase in impact.
Land, Soils and Geology	Larger works footprint at Ballyvool, leading to slightly greater potential for impact	Longer grid connection within the site resulting in a larger footprint, therefore leading to a greater potential for impact.
Hydrology and Hydrogeology	Larger works footprint at Ballyvool, leading to slightly greater potential for impact	Longer grid connection within the site resulting in a larger footprint, therefore leading to a greater potential for impact.
Visual Impact	Potential for significantly higher impact from new substation at Ballyvool as a result of the visibility of the site.	Neutral
Noise and Vibration	Neutral	Neutral
Cultural Heritage	Neutral	Neutral

Traffic	Significant level of construction traffic outside of the main wind farm site only accessible via small local roads leading to greater potential for traffic impact.	Neutral

All reasonable potential grid connection solutions were examined during the design phase. A grid route feasibility assessment was conducted which considered 5 no. other alternative grid routes, to include two on-site substation location options at Castlebanny Windfarm and two proposed substation locations approximately 3km east of the site nearby an existing 110kV line. Overhead lines were considered early in the process but were excluded due to a much higher potential to cause a visual impact.

The alternative options as per Figure 3-5 below are summarised as follows.

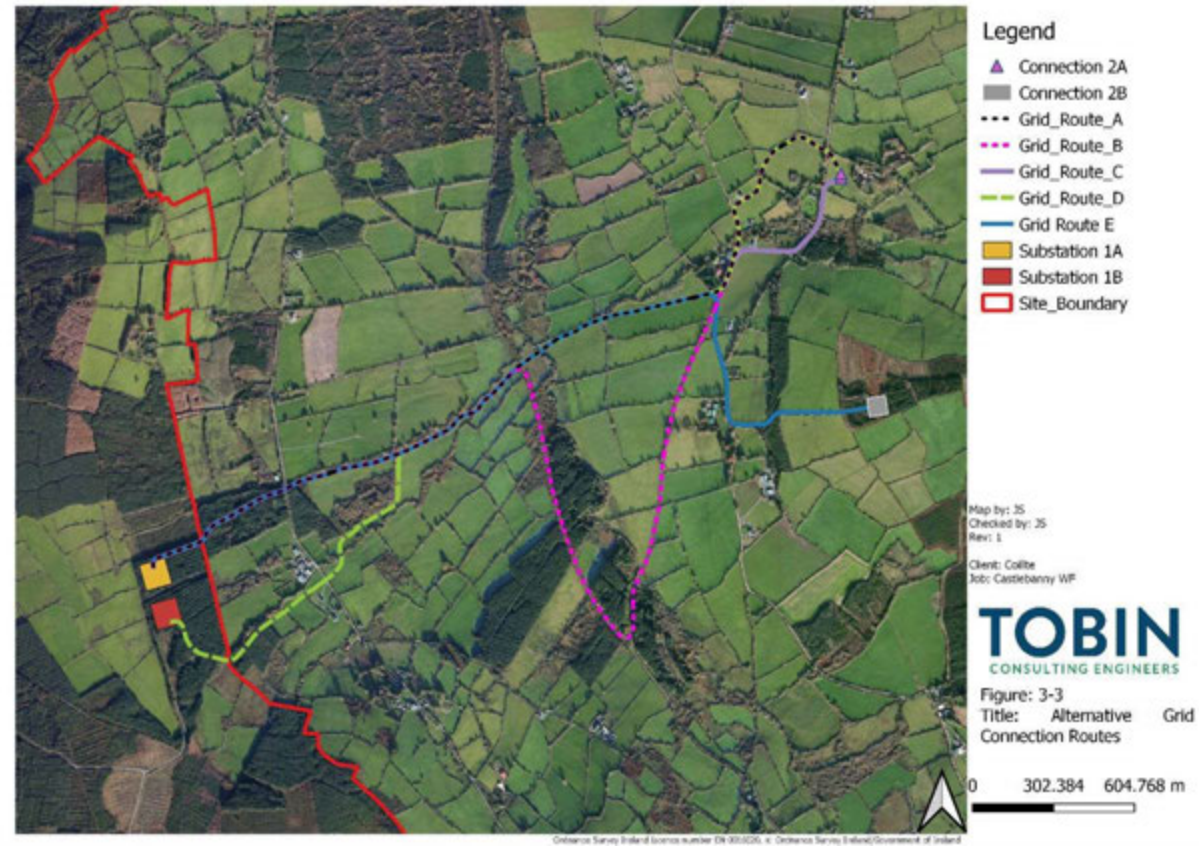

Figure 3-5: Alternative Grid Route Assessments.

Grid Route A (as delineated in dashed black in Figure 3-5 above) was for a 3,334m long 110kV grid route from Connection point 1A in Coillte lands to connection 2A on private lands under the existing 110kV overhead lines. There will be 300m located within the public road with the remainder of the route located in private lands and will require a 3m wide access track built over the cable trench (where not in road) in accordance with EirGrid Specification. This route selection had the following minimum number of crossings and chambers:

- 1 HDD crossing through SPA.
- 1 No. Transition Pit

- 1 bridge crossing.
- 4 culvert crossings
- 4 No. 110kV Joint bays
- 2 No. Link Boxes
- 6 No. Communication Chambers

This route (Grid Route A) was eventually chosen as the preferred route, albeit with a few minor refinements to suit localised constraints and the exact location of the onsite substation.

Grid Route B (as delineated in dashed pink above) was for a 4,985m long 110kV grid route from Connection point 1A in Coillte lands to connection 2A on private lands under the existing 110kV overhead lines. There would be 2,750m located within the public road with the remainder of the route located in private lands and would have also required a 3m wide access track built over the cable trench (where not in road) in accordance with EirGrid Specification. This route selection had the following minimum number of crossings and chambers:

- 1 bridge crossing.
- 4 culvert crossings
- 7 No. 110kV Joint bays
- 3 No. Link Boxes
- 9 No. Communication Chambers

Grid Route C, (as delineated in purple above) was for a 3,126m long 110kV grid route from Connection point 1A in Coillte lands to connection 2A on private lands under the existing 110kV overhead lines. There would be 300m located within the public road with the remainder of the route located in private lands and would require a 3m wide access track built over the cable trench (where not in road) in accordance with EirGrid Specification. This route selection has the following minimum number of crossings and chambers:

- 1 HDD crossing through SPA
- 1 No. Transition Pit
- 1 bridge crossing.
- 4 culvert crossings
- 3 No. 110kV Joint bays
- 2 No. Link Boxes
- 5 No. Communication Chambers

Grid Route D, (as delineated in dashed green above) was for a 3,667m long 110kV grid route from Connection point 1B in Coillte lands to connection 2A on private lands under the existing 110kV overhead lines. The majority of the route was in private lands and would require a 3m wide access track built over the cable trench (where not in road) in accordance with EirGrid Specification. This route selection had the following minimum number of crossings and chambers:

- 1 HDD crossing through SPA
- 1 No. Transition Pit
- 1 bridge crossing.
- 5 culvert crossings
- 5 No. 110kV Joint bays
- 3 No. Link Boxes
- 7 No. Communication Chambers

Grid Route E, (as delineated in blue above) was for a 3,334m long 110kV grid route from Connection point 1A in Coillte lands to connection 2B on Coillte lands under the existing 110kV overhead lines. The majority of this route was in private lands and would have required a 3m wide access track built over the cable trench (where not in road) in accordance with EirGrid Specification. This route selection had the following minimum number of crossings and chambers:

- 1 HDD crossing through SPA
- 1 No. Transition Pit
- 3 culvert crossings
- 4 No. 110kV Joint bays
- 2 No. Link Boxes
- 6 No. Communication Chambers

Grid Route options A, C, D and E, as compared in Table 3-8, were of similar distances. Grid route options A, B, C and E all began at Substation connection 1A while route Option D began at Substation connection 1B. Route options A, B, C and D all terminated at Substation connection 2A, while grid route option E terminated at Connection 2B. From consideration of the viable options, the proposed option as outlined in Figure 2-4 (Chapter 2, Description of the Proposed Development) was chosen, as this offers reduced environmental effects in comparison with the other viable alternatives. It should be noted that the eventual substation location is slightly different from Connection Points 1A and 1B as described further up but the assessment is still valid. The options are discussed in Table 3-9 below.

Table 3-9: Table of environmental effects relative to chosen grid connection route (taken as Grid Route A above)

Environmental Considerations	Route B	Route C	Route D	Route E	Overhead line
Human Health and Population	Route runs along local roads for significant portions. Potential for slightly increased impact.	Neutral	Neutral	Neutral	
Biodiversity	Use of existing road crossing across River Barrow and River Nore SAC, but route runs alongside the SAC for a considerable distance. Overall neutral impact compared to proposed route.	Neutral	Neutral	Neutral	Slight increased risk to birds.
Land, Soils and Geology	Longest route will require more excavations relative to all of the other options. Potential negative impact.	Shortest route, will require minimum excavations, so potential positive impact	Neutral	Neutral	Slight positive due to decreased groundworks

Hydrology and Hydrogeology	River Arrigle will be crossed at an existing bridge but route is longer. Slight increased negative impact due to increased excavation works.	Stream and River crossing. New crossings of both water features. In addition, this option runs parallel and adjacent to a stream, giving rise to more potential for downstream effects. Overall slightly increased potential for impact	Neutral	Neutral	Less potential for effects on nearby streams as less groundworks required
Air and Climate	Longest route will require more excavations, and thus more vehicle emissions, leading to an increased potential impact.	Shortest route will require the least excavation so fewer vehicle emissions, leading to a decreased potential impact	Neutral	Neutral	Shorter, straight route, slight positive relative to chosen option
Cultural Heritage	Neutral	Neutral	Neutral	Neutral	Neutral
Traffic	Longer distance of the grid route on public road corridors, leading to an increased potential impact.	Neutral	Neutral	Neutral	Less work on public road corridor, therefore potential impact on traffic is likely to be lower
Landscape & Visual Impact	Neutral	Neutral	Neutral	Neutral	Negative impact relative to chosen option

The current proposal includes an onsite 110kV substation with a loop-in underground grid connection to the existing 110kV overhead line in Ballyvool as shown in Figure 2-4 of this EIAR. Two new end masts will be required in Ballyvool to allow for the connection, drawings of which can be seen in Appendix 2-1 of this EIAR. The overall length of the proposed grid connection (which follows the general route of option A above) between the proposed substation and the existing overhead line is approximately 4km, of which, approximately 1km is within the site of the proposed wind farm, and approximately 0.3km is located along the public road corridor. The remaining approximately 2.7km is located off road in private lands.

Route A will employ Horizontal Directional Drilling in order to minimise effects on Biodiversity and Hydrology and Hydrogeology, effectively passing underneath the River Arrigle (part of the Roiver Barrow and River Nore SAC) and the Mullenakill stream that discharges into the SAC. The proposed route was also adjusted to increase distances between the grid corridor and streams discharging into the River Arrigle. The grid route originally was located alongside an

unnamed stream that joins the Mullenakill stream before discharging into the River Arrigle from the west of the river and then alongside the Garrandarragh stream which discharges into the River Arrigle from the east. As part of design mitigation, the grid route was amended to run between the unnamed stream and the Mullenakill stream, eventually crossing the Mullenakill stream then the River Arrigle by HDD. On the eastern side of the river the grid route was adjusted to keep 150m on the far side of the field south of the Garrandarragh stream, before eventually crossing it over a culvert in the road to get to the connection point.

3.3.5 Alternative Processes

The process selection for alternative renewable energies, was largely carried out after Castlebanny was chosen as a suitable site for wind energy development. As described previously this site selection process was driven by the suitability of areas within the Coillte landbank for wind energy. Only when this site was identified, were the full suite of potential technologies for the production and supply of renewable energy to the Irish national electricity grid considered. The following section outlines the alternative technologies and respective considerations in relation to the chosen alternative for the project, onshore wind.

3.3.5.1 Solar Energy

There has been a recent surge of interest in solar energy in Ireland due to rapid improvements in solar technology and cost competitiveness. A report undertaken by KPMG entitled *A Brighter Future – Potential Benefits of Solar PV in Ireland* (November 2015)[9], detailed the potential impacts of solar energy on the Irish electricity network and market, and how it will interact with other technologies, principally onshore wind.

The report notes that while solar PV would diversify Ireland's renewable energy portfolio, its output is unlikely to be correlated with that of wind.

The KPMG report notes that: "*Ireland's progress to date towards meeting its targets has principally been through the deployment of onshore wind energy. Onshore wind will continue to be the principal means of meeting Ireland's 2020 targets, with a total of 3.2-3.7GW projected to be commissioned by 2020".*

Therefore, while solar energy could in theory be implemented at the site as a reasonable alternative to wind energy, it would be less productive in terms of energy output for the same footprint and will contribute less towards meeting Ireland's renewable energy targets. The environmental and financial impacts would be more extensive in terms of the area of forestry required to be felled and replanted elsewhere to accommodate a solar farm. The capacity factor of solar energy is significantly lower than that of onshore wind energy, requiring approximately 3 times the capacity of the proposed wind farm development, (approx. 345MW) to produce the same amount of energy. Taking solar farms to require 1.6-2 hectares per MW, the land area required to be permanently felled would be in the region of 550 to 690 hectares. This area of land would also have to be acquired and replanted elsewhere. There are likely to be increased effects on land use, geology, and hydrology as well as biodiversity, as a result of increased felling works.

Furthermore, it is likely that solar PV may have a knock on impact on Biodiversity through the mimicry of sensory cues (i.e. shimmer/glare similar to water), habitat loss and glare as well as Hydrology and Hydrogeology, through increased water consumption and runoff.

[9] KPMG (2015), A Brighter Future. Available at: http://www.irishsolarenergy.org/news-docs/A-Brighter-Future.pdf

Large scale solar farms require a significantly larger footprint than wind farms to produce the equivalent level of electricity. This technology can therefore have a greater environmental impact, especially in forested lands. A wind farm is proposed at this site for the reason that wind energy produces the lowest level of environmental effects at the site. The options are discussed in Table 3-10 below.

Table 3-10: Table of environmental effects relative to proposed wind farm technology

Environmental Considerations	Solar
Human Health and Population	No potential for shadow flicker, but there is a potential for glint/glare for road users.
Biodiversity	Increased habitat loss due to larger development footprint, and potential for avifauna impacts due to glint/glare.
Land, Soils and Geology	Greater development footprint resulting in larger areas of excavations.
Hydrology and Hydrogeology	Larger felling area would result in increased risk of silt runoff to local watercourses
Air and Climate	Longer carbon payback period associated with solar energy developments.
Aviation & Telecommunications	Less potential to impact on telecommunication links or flight activity.
Landscape and Visual Impact	Potentially less visible from locality due to topographical and vegetative screening.
Noise and Vibration	No potential for noise impacts from solar
Cultural Heritage	More potential for impact on cultural heritage due to the increased site footprint
Traffic	Increased potential for impacts in the construction phase due to the larger number of traffic movements required to clear larger area of forest and to bring the infrastructure to site.

The proposed lands by their relatively remote nature can facilitate large scale developments such as wind farms. In tandem with this, wind is highly efficient in terms of energy output per unit area and as such will be a valuable contribution of renewable energy to the national grid Overall, the Castlebanny site is classed as a highly suitable location for the deployment of wind energy.

3.3.6 Mitigation Measures

The mitigation measures proposed in relation to the elements of the project are detailed in the chapters to follow and are also summarised in Chapter 18 Schedule of Mitigation Measures. The mitigation measures proposed are considered to be proven and best practice. The level of mitigation proposed is determined to be proportionate to the potential impact. On this basis, the chosen mitigation measures are those that are considered to have the least environmental effects.

The most significant mitigatory measures considered in this chapter have been those which avoid developing on or minimising effects on environmentally sensitive areas and local population.

3.4 CONCLUSIONS

A description of the reasonable alternatives in terms of project design, technology, location, size and scale has been studied by the developer. The options which are relevant to the proposed project and its specific characteristics of a large scale wind farm in an upland rural area have been discussed. The overriding reason for selecting the chosen options is to maximise the renewable energy production from the site while minimising the environmental impact. For each alternative, a comparison of the environmental effects has been provided, showing the reasons for the chosen option being favoured relative to the others.

As discussed above the siting and design of the proposed wind farm development has evolved through the consideration of alternatives and allowing for stakeholder input into the process. This included initial consideration of the need for renewable energy, the site selection process, the consideration of different viable alternative processes to produce renewable energy, and alternative layouts, scales, and design processes.

Reasonable alternatives were considered with specific regard to the characteristics of the project. Comparisons of environmental effects were noted . The alternatives chosen focused on mitigation by design in order to avoid potential impacts on the environment.

When weighed against all of the alternatives and constraints/facilitators outlined in this chapter, the proposed Castlebanny Wind Farm site has been found to be a highly suitable location for a wind farm site with regard to a number of criteria including wind speed, environmental effects, distance from dwellings and landscape character. The location is particularly appropriate with regard to the foregoing and with regard to ease of access, and proximity to the grid connection.