MWP

Chapter 03 Consideration of Alternatives

Ballinlee Wind Farm

Ballinlee Green Energy Ltd.

September 2025

Contents

Tables

Figures

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3. Site Selection and Reasonable Alternatives

3.1 Introduction

This chapter of this EIAR presents a description of the site selection process for the proposed development and the reasonable alternatives to the proposed development (for example in terms of the project design, location, size and scale) that were studied by the Applicant, which are relevant to the proposed development and its specific characteristics, and a discussion of the main reasons for selecting the chosen option, taking into account the effects on the environment.

3.1.1 Competency of Assessor

This chapter of this EIAR has been prepared by Serena O'Donnell of Malachy Walsh & Partners (MWP). Serena has a BA Honours (Geography) and MSc. Applied Environmental Geoscience and is a graduate Environmental Scientist at MWP. Serena has experience in environmental consultancy since 2024, and in this time has worked on a variety of environmental projects including Inis Cealtra Visitor Centre, Ballinla Wind Farm, Shronowen Wind Farm and Bantry Culvert, assisting with the preparation of EIAR chapters, including alternatives and lands and soils chapters, Environmental Impact Reports, Geotechnical Interpretative Reports, Geotechnical Assessment Reports, Construction and Environmental Management Plans (CEMPs) and Resource Waste Management Plans (RWMPs).

This assessment has been reviewed by Aileen O'Connor (MWP), BSc(Hons), PGDip, who has over 13 years' experience in the environmental field both in industry and consultancy work. Aileen is a Senior Environmental Consultant and holds a BSc(Hons) in Environmental Science and PGDip in Energy Management. Aileen is an experienced and competent environmental professional with a background in contaminated land assessment, licence compliance and waste management. Aileen has prepared and peer reviewed chapters of EIARs and has coordinated and delivered many environmental assessment reports and consent applications for transmission and power generation projects including the preparation of Resource Waste Management Plans RWMPs and contributed to Material Assets Impact Assessments. More specifically, she has worked on a wide variety of projects during her career to date including wind farms, marine, quarries, industrial and commercial developments.

3.2 Background

The consideration of Alternatives to a proposed development is a mandatory part of the EIA process. The legal requirements of the EIA Directive, relating to the assessment of Alternatives, are set out in Article 5(1)(d) and Annex IV point 2 of the Directive.

Article 5(1) states that the development shall include at least:

> d) 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;

Annex IV point 2 expands further:

2) 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 EU Commission guidance document 'Guidance on the preparation of the Environmental Impact Assessment Report' (2017) defines alternatives as: 'Different ways of carrying out the Project in order to meet the agreed objective'. That Guidance states 'The number of alternatives to be assessed has to be considered together with the type of alternatives, i.e. the 'Reasonable Alternatives' referred to by the Directive. 'Reasonable Alternatives' must be relevant to the proposed Project and its specific characteristics, and resources should only be spent assessing these Alternatives. In addition, 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.'

Ultimately, alternatives have to be able to accomplish the objectives of the Project in a satisfactory manner, and should also be feasible in terms of technical, economic, political and other relevant criteria.

Section 3.4 of the 2022 EPA guidance "Guidelines on the information to be contained in Environmental Impact Assessment Reports" contains Guidelines on the consideration of alternatives within the EIAR. It states:

> *"The objective is for the developer to present a representative range of the practicable alternatives considered. The alternatives should be described with 'an indication of the main reasons for selecting the chosen option. 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."*

That guidance also states that analysis of high-level or sectoral strategic alternatives cannot reasonably be expected within a project level EIAR.

3.3 Scope

The purpose of the alternatives analysis is principally to examine the different possibilities for meeting the needs and objectives of the proposed development, which is to construct and operate a windfarm, and to determine whether or not the objectives can be met by different means that avoid, minimise, or mitigate potential significant environmental effects.

During the development design process, alternative wind farm layouts and scales were fully considered in order to find the optimum design solution for the site with the least level of environmental impact. This chapter therefore outlines the site selection process, the process of design evolution for the proposed development, the reasonable alternatives considered during the project inception and design process including a comparison of the environmental effects and the principal reasons for proceeding with the current planning application.

3.4 Site Selection Process

The process of identifying a suitable wind farm site is influenced by a number of factors. At a macro scale: national and regional planning policy together with distance from designated conservation sites; available grid capacity; cumulative impacts with existing and permitted wind farms, as well as other permitted and proposed developments, and available wind speeds in an area are all integral factors. Interrelated to this, the wind farm must, in non-environmental terms, be commercially viable to ensure it will attract the necessary project finance to progress to the construction phase and ultimately deliver renewable electricity to the National Grid which is an objective of current National renewable energy policy as set out in the **Planning Statement** accompanying this EIAR.

Prior to selection of the site suitable for such development, a detailed screening exercise was undertaken by the Applicant using a number of criteria and stages to assess the potential of a large number of possible sites, on lands under consideration, suitable to accommodate a wind energy development. In locating potential sites, the Applicant carried out a desk-based Geographical Information System (GIS) screening exercise. This identified all designated conservation sites (SAC, SPA, NHA), protected views/routes, cultural heritage sites (NMS and NIAH), and other areas of special sensitivity (specified in relevant development plans).

The proposed development site was the site identified as most suitable to take forward as a potential wind farm location.

The following steps were followed for the screening process:

- Phase 1 Initial Screening;
- Phase 2 Grid Constraints and Facilitators;
- Phase 3 Other Constraints and Facilitators; and
- Site Validation.

3.4.1 Phase 1 Initial Screening

A number of criteria were applied in order to identify which lands/sites might be available, in principle, for wind energy development. The Applicant reviewed the Limerick Development Plan 2022-2028 and Renewable Energy Strategy provisions and discounted sites where policy would not be supportive of wind energy developments for the wind farm site. In this regard, sites were discounted if they were not identified as being at least 'Open for Consideration' for wind energy development in the relevant Plans/Strategies or if they were within designated conservation areas (Natura 2000).

Figure 3-1 illustrates that the wind turbines associated with the proposed development is located within a 'Preferred Area' for wind energy development designated in the current Limerick Development Plan 2022-2028.

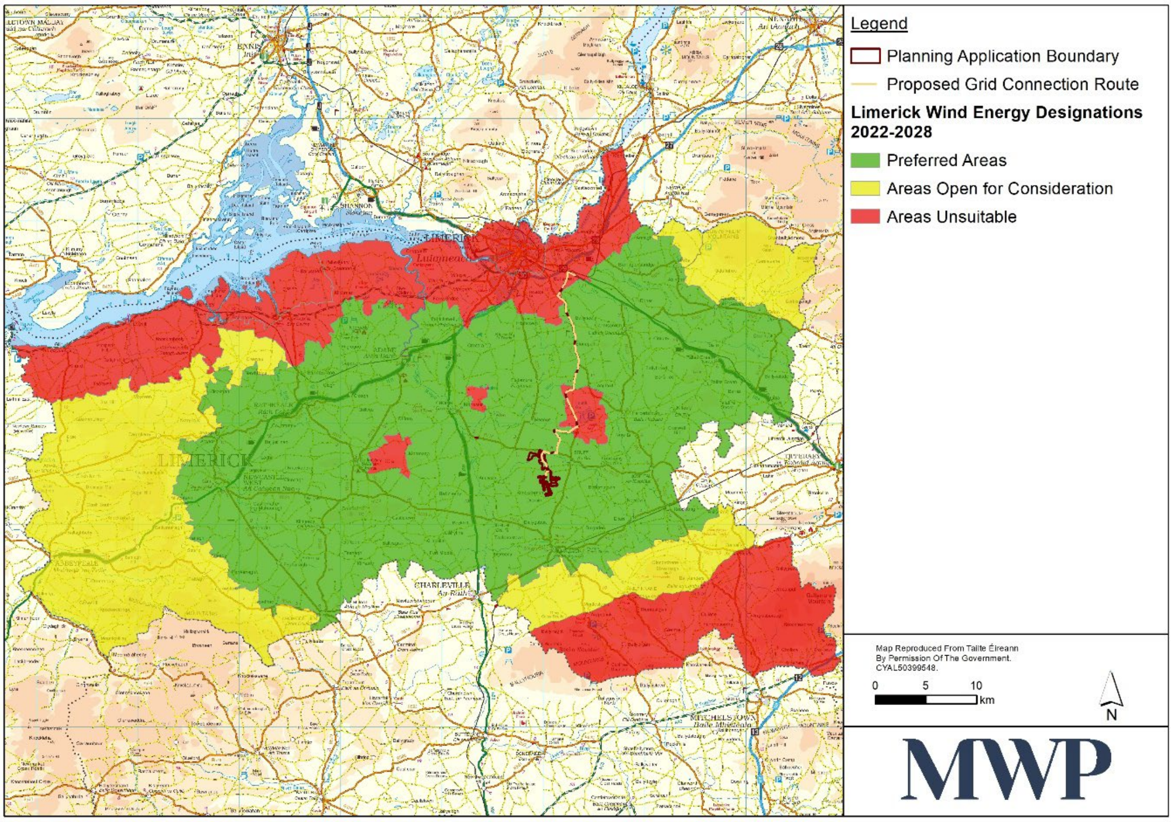

Figure 3-1: Site Selection based on Wind Energy Designations

The result of applying the Phase 1 Screening criteria was that nine (eight plus the proposed development) potential wind farm sites were identified (Figure 3-2). These were then subject to further assessment and screening, as outlined in Table 3-1.

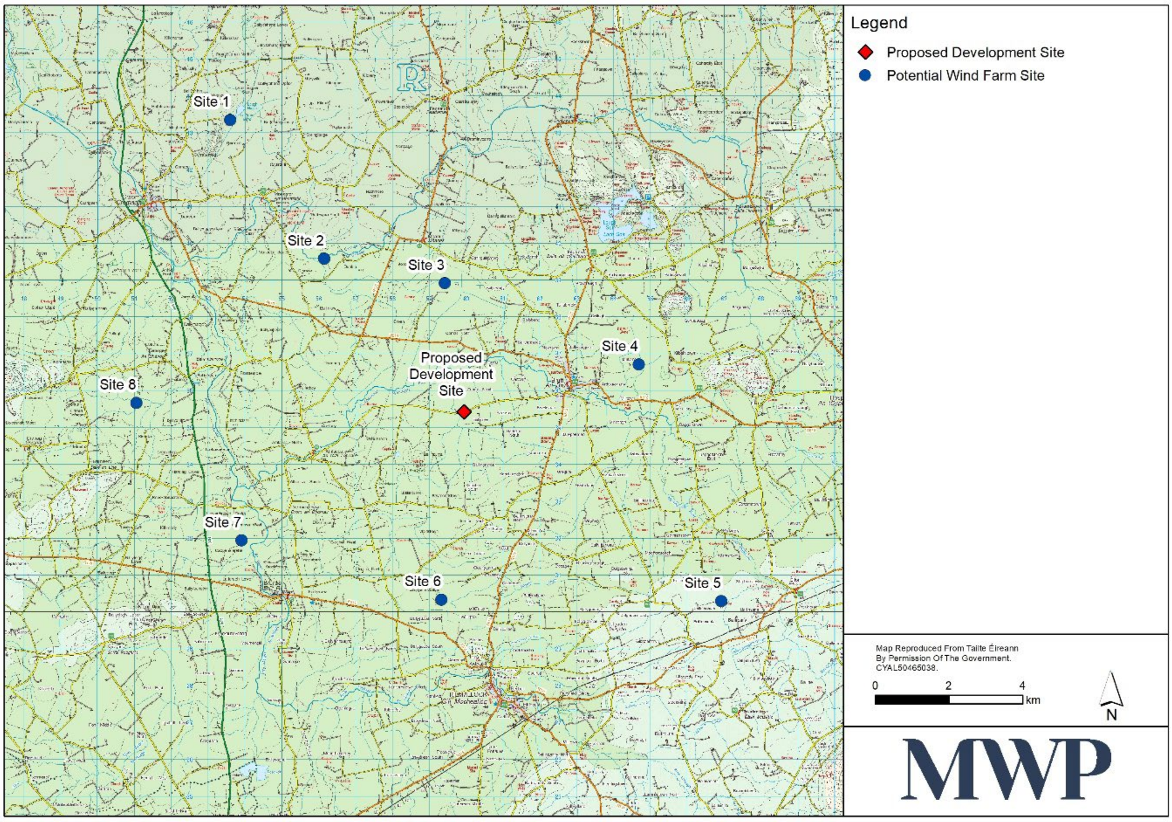

Figure 3-2: Potential Sites Identified as part of Initial Screening

3.4.2 Phase 2 Potential for Grid Connection

As part of the site selection process, the Applicant considered the potential for grid connection, including distance to potential connection points and the capacity of the grid to accommodate the proposed development.

3.4.3 Phase 3 Other Constraints and/or Facilitators

Phase 3 Screening included consideration of known local issues or other constraints and/or facilitators. These included the following:

- Amenity, Tourist or Scenic Areas designated in development plans, e.g. Landscape Character Areas, Scenic Views;
- Size of Site/ Development Area, i.e. if site is of insufficient size to be capable of supporting a viable project;
- Sensitive habitat/species of bird;
- Land Ownership Issues;
- Residential density considerations;
- Potential project scale; and
- Sites with impractical/irregular shape/layout/ topography.

The application of the above criteria resulted in the discounting of further sites, leaving a reduced number of sites for further assessment. The site selection process was, by necessity, strategic and desk-based in nature in order to devise a short list of candidate sites. This is considered to be a rational and appropriate approach and its implementation was clearly founded on knowledge and observation. The proposed development was identified as most suitable to take forward as a potential wind farm location. **Table 3-1** outlines the various sites identified and the reason for not proceeding.

Based on the screening process, the proposed development was the preferred candidate site of scale to take through to the next stage of validation.

Table 3-1: Screening of Potential Sites Identified

Site	Screening – Reason for Not Proceeding
1	Part of the land folios within the area are designated as 'unsuitable' in the Limerick Development Plan, with the remainder designated as 'Preferred'.
2	There are a number of rivers that traverse the site, including the Camoge, Clonmore, Dunkip Rivers, which constrain the extent of buildable land within the area. Heavy concentration of archaeological sites.
3	There are a number of rivers that traverse the site, including the Camoge, Killorath, Camas North Rivers, which constrain the extent of buildable land within the area. Heavy concentration of archaeological sites. 110kV Overhead Line (OHL) from Charleville to Killonan in close proximity to the western side of the site which would require a setback distance.
4	There are a number of rivers that traverse the site, including the Ballycampion, Meadagh Rivers which constrain the extent of buildable land within the area. Proximity to Lough Gur – Potential landscape and visual impacts. Residential density considerations as located approximately 1km from Bruff.
5	There are rivers that traverse the site, including the Stephenstown River which constrain the extent of buildable land within the area. Site access is difficult due to the presence of a river. The presence of archaeological sites at the centre of the area would make it difficult to link internal access tracks with potential turbine locations.
6	There are rivers that traverse the site, including the Clogher East, Ballinculloo and Wellfield Rivers. Site access is difficult because of potential river crossings. The presence of archaeological sites at the centre of the area would make it difficult to link internal access tracks with potential turbine locations.

Site	Screening – Reason for Not Proceeding
7	Potential Project Scale – Insufficient development area. Residential density considerations as located 1km from Bruree Villlage.
8	There are rivers that traverse the site, including the West Liskennett, Pullagh, Knockannacreeva, Morenane Rivers which constrain the extent of buildable land within the area. Residential density considerations as located 1km from Banoge village.

3.4.4 Site Validation

The proposed development, as a candidate 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 proposed development included:

- Consistently high average annual wind speeds;
- Obtainable and economic grid connection;
- Limerick Development Plan policies and objectives;
- Located outside areas designated for protection of ecological species and habitats;
- Set back distance from residential dwellings;
- Site topography and stability; and
- Access issues for turbine delivery and construction activities.

The above exercises, based on a number of key environmental, technical and policy-related criteria, determined that the proposed site represented a suitable location for the proposed development in Limerick. The site has satisfied a number of key criteria required for successful wind energy development and these are presented in **Table 3-2**.

Table 3-2: Summary of Site Suitability Criteria

Suitability Criteria	Proposed Development Site
Wind Resource	The predicted wind speed at the proposed development is approximately 7.5 – 7.6m/s as shown in the Sustainable Energy Authority of Ireland's (SEAI) Wind Atlas.
Proximity to Grid	Proximity to the existing 220/110kV substation at Killonan which is approximately 27.6km north of the proposed site.

Suitability Criteria	Proposed Development Site
Compliance with Planning Policy/Designation	The Limerick Development Plan 2022– 2028 Wind Energy Map 9.1 has identified the site as being within a 'Preferred Area' for wind energy development.
Avoidance of Environmental Designations	The proposed development does not overlap with any Natura 2000 sites.
Set Back Distance from Residential Dwellings	As per the Draft Revised Wind Energy Development Guidelines (2019) a minimum setback distance of four times turbine tip height of 640m (4x160m) for T1-T5 and T7-T17 and 600m (4x150m) for T6 was applied to residential dwellings in the surrounding area. This setback is achieved at the proposed development. There are no existing residential dwellings within 640m of T1-T5 and T7-T17 and within 600m of T6.
Site Accessibility	The main site entrance is via the R516 Regional Road between Croom and Bruff on the north side of the wind farm site. This will be a new entrance close to an existing farm/dwelling entrance along the R516.
Landscape and Visual Impact	The site is located within the Landscape Character Area LCA 01 Agricultural Lowlands, a mainly flat, farming landscape containing some of the areas designated as suitable for wind developments. The policy for wind developments within this LCA is to "Encourage the regular arrangement of turbines with equal spacing in proposed wind farm developments, which take field boundaries into account".

3.4.4.1 Compliance with Planning Policy/Designation

Objective CAF 028 of the Limerick Development Plan 2022-2028 states: 'It is an objective of the Council to encourage the development of wind energy, in accordance with Government policy and having regard to the principles and planning guidance set out in the Department of Housing, Planning and Local Government publications relating to *Wind Energy Development* and the DCCAE *Code of Practice for Wind Energy Development in Ireland* and any other relevant guidance, which may be issued in relation to sustainable energy provisions during the course of the Plan'.

Objective CAF O30 regarding the Location of Wind Energy Developments states: 'It is an objective of the Council to promote the location of wind farms and wind energy infrastructure in the 'preferred areas' as outlined on Map 9.1, to prohibit such infrastructure in areas identified as 'not open for consideration' and to consider, subject to appropriate assessment, the location of wind generating infrastructure in areas 'open for consideration'. A target of 386.45MW by 2030 is proposed in the development plan, which is 65% above the current capacity within the county. The wind farm site is located within an area designated in the current Limerick Development Plan 2022-2028 as a 'preferred area' for wind energy development (refer to Figure 3-1).

3.4.4.2 Avoidance of Environmental Designations

This proposed development site is not within a Natura 2000 site, as shown in Figure 3-3.

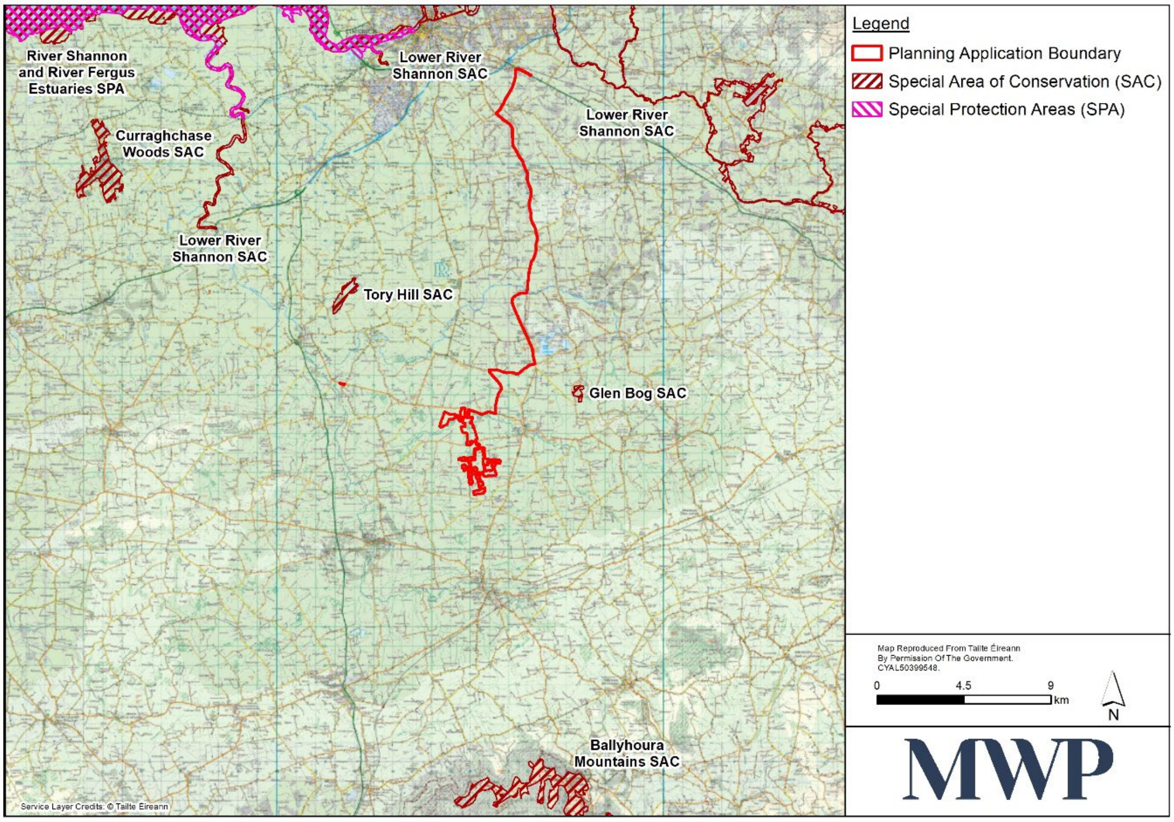

Figure 3-3: Location of Designated Natura 2000 sites

3.4.4.3 Landscape and Visual Impact

The current Limerick Development Plan contains policy objectives relating to Landscape Conservation Areas, Areas of Special Amenity and also for the assessment of landscape character. It discourages projects on 'sensitive or sloping sites', which this site is not. The site is located within the designated Rural Landscape Character Area LCA01 Agricultural Lowlands which is the largest LCA in Co. Limerick and is mainly a flat farming landscape, however the spacing afforded between the turbines will maintain a high degree of visual permeability to ensure that visual relationships with the wider landscape will remain available, and the underlying features and characteristics of the landscape will be retained.

3.5 Design Process

There are a number of drivers that will ultimately influence how a design layout for a project evolves. For a wind farm development, this is usually concerned with location and placement of development components within a limited footprint at the site, which is largely defined by aspects such as noise, set-back from residential dwellings, habitat, access, grid connectivity and ground conditions, including slope and drainage regime.

The proposed wind farm has been designed to minimise potential environmental impacts and to maximise wind potential on site. The design was developed following an assessment of the environmental impacts of potential locations which informed and identified the buildable areas suitable for turbines, tracks and infrastructure based on avoidance of unsuitable areas and following the good practice of mitigation by design.

3.5.1 Identification of Environmental Sensitivities

The EIA process involved the completion of all baseline studies to generate environmental constraints and facilitators that informed the design for the optimum wind farm layout. These studies were undertaken by the environmental, planning and engineering professionals that made up the Project Design team (outlined **Volume II**, **Chapter 01** Introduction of this EIAR). Site surveys undertaken between 2021 and 2025 have informed this EIAR and planning application.

Following consultation and baseline assessment of the proposed development, the following are the key environmental factors identified:

- Topography;
- Sensitive Habitats;
- Bat Ecology;
- Public Roads and Population Density;
- Ornithology;
- Soils and Geology;
- Hydrology;
- Archaeology; and
- Landscape and Visual.

This analysis of constraints identified the potential for environmental impacts, associated with the proposed development, without design mitigation/other mitigation measures. Environmental concerns consisted of constraints or setback distance. Buffers and set back distances are the principal tool used by wind farm designers when incorporating mitigation by design and avoidance. This can only be done when all the environmental sensitivities have been established across the project area. Buffers and set back distances derived from relevant guidance documents such as the Wind Energy Development Guidelines, stakeholder input, studies (as outlined above) and project experience are then put in place.

Table 3-3 summarises the physical and environmental constraints which have informed the wind farm design.

Table 3-3: Physical and Environmental Sensitivities

Study Area	Design Constraint
Topography	Ground areas with slope greater than 30° were deemed unsuitable for development.
Sensitive Habitats	Identification of habitat type within the site and minimisation of infrastructure within ecologically valuable habitat.
Bat Ecology	The felling buffer ranges from 73.9m to 97.1m from the centre of each turbine to woodland areas as recommended in Scottish Natural Heritage Guidelines (2021).
Public Roads	The Draft Revised Wind Energy Development Guidelines 2019 state 'it is advisable to achieve a safety set back from National and Regional roads and railways of a distance equal to the height of the turbine to the tip of the blade plus 10%'.
Ornithology	Bird surveys were carried out over winter seasons since 2021 and summer seasons since 2022. This data was available and used during the design process.
Soils and Geology	Identification of soil type and rock outcrops. Avoidance of unsuitable areas and constructability risk areas.
Hydrology	All open water bodies adjacent to areas of proposed works, including settlement ponds, will be protected by fencing. A minimum 50m buffer to EPA mapped watercourses will be retained for construction works except for crossings and other works.
Archaeology	Minimum distance of 20m from areas of Archaeological importance, based on professional judgement.
LVIA	Identification of Zones of Theoretical Visibility (ZTV) within 20km of the proposed development, as per the Wind Energy Guidelines (2006) and Draft Revised Wind Energy Development Guidelines (2019).
Noise Sensitive Receptors	A minimum distance from proposed turbine locations to nearest existing residential dwellings has been applied. The Draft Revised Wind Energy Development Guidelines (2019) advise a setback of at least four times the tip height (150m for T6 and 160m T1-T5 and T7 to T17) from the turbine centre to noise sensitive receptors, which equates to 600m for T6 and 640m for T1-T5 and T7 to T17. The final design achieved the setbacks as outlined from existing dwellings.

3.5.1.1 Topography

The topography of the proposed development is relatively flat which is advantageous, particularly in construction. Elevations of the site range between approx. 49 -79m AOD in areas where infrastructure is to be developed. A flat site is less challenging in terms of construction and the delivery of turbine components, equipment and materials. The risk of impacting ground stability during excavation is also minimised.

The following approach was taken regarding infrastructure layout and ground slopes. The ground surface gradients were determined from 2m Lidar data. Using this, the proposed development infrastructure layout was selected and optimised such that areas of minimum gradient were utilised. The maximum slope of the wind farm area is approximately 6.7% and therefore was considered suitable for all types of wind farm infrastructure. This approach is based on the experience/recommendations of the project design team who have extensive knowledge and experience in the design and construction of wind farm developments in similar topography.

3.5.1.2 Sensitive Habitats

The proposed development has been designed to minimise the footprint within sensitive habitats. This has been achieved in collaboration with engineering constraints, for example by taking account of habitat value from ecological site visits and survey work and areas potentially impacted. The proposed development design has followed the basic principles outlined below to reduce and where possible eliminate the potential for significant effects on ecological receptors:

- Avoidance/minimisation of turbine array and wind farm infrastructure at sensitive habitats (e.g. hardstanding areas designed to the minimum size necessary to minimise habitat loss);
- Avoidance of wildlife refuge sites (e.g. waterbodies) insofar as possible; and
- The grid connection route and internal tracks were selected to utilise existing built infrastructure for the majority of their lengths where possible (i.e. cables to be laid within public roads and existing tracks where possible).

3.5.1.3 Bat Ecology

For sites such as at the proposed development, the SNH guidance document 'Bats and Onshore Wind Turbines: Survey, Assessment and Mitigation' (SNH, 2021) recommends a buffer of 50m between a turbine blade tip and the nearest valuable foraging habitat to bats. In the case of the proposed turbines, the foraging features likely to be used by bats are the hedgerows forming field boundaries within the proposed development. The 50m buffer creates a clearance setback of 50m between the arc of the blade's sweep and the nearest hedgerow which could be used by bats without risk of collision with the turbine blades. Based on SNH buffer formula and proposed turbine dimensions, a felling distance around each proposed turbine will be required to minimise impacts to foraging bats. The 73.9m bat buffer distance calculation for T1 and T9, 89.4m bat buffer distance calculation for T2, T8, T10, T11, T12 and T14, 79.1m bat buffer distance calculation for T7, 79.7m bat buffer distance calculation for T3, T13, T15, T16 and T17 and 97.1m bat buffer distance calculation for T4, T5 and T6 is based on a proposed turbine blade length of 68m, hub height of 92m for T1 - T5 and T7 - T17, and for T6 the proposed turbine blade length of 68m, hub height of 82m was used. 5m was used for hedgerow height, 15m was used for treelines and 25m was used for forestry depending on the type of vegetation around the turbine. Further details in relation to the calculation and buffers is provided in Volume II, Chapter 06 Biodiversity of this EIAR and Volume III, Appendix 6E Baseline Report on Bat Surveys of this EIAR.

3.5.1.4 Public Roads

With regard to the proximity of the wind turbines to public roads and railways, the 2006 Wind Energy Development Guidelines states 'Although wind turbines erected in accordance with standard engineering practice are stable structures, best practice indicates that it is advisable to achieve a safety set back from National and Regional roads and railways of a distance equal to the height of the turbine and blade.' In the case of the proposed turbines, that would equate to 150m for T6 and 160m for T1 to T5 and T7 to T17. The Draft Revised Wind Energy Development Guidelines 2019 state 'it is advisable to achieve a safety set back from National and Regional roads and railways of a distance equal to the height of the turbine to the tip of the blade plus 10%.'

The setback distance specified in the Draft Revised Wind Energy Development Guidelines 2019 (160+10% = 176m and 150+10% = 165m) from the nearest National and Regional roads has been applied to the proposed development.

As per the Turbine Delivery Route Assessment (EIAR Volume III, Appendix 2C) the delivery route from the port at Foynes, County Limerick to the proposed development is feasible for all turbine components related to the proposed development. Due to the proximity of Foynes Port to the proposed development (approximately 50km) and extensive previous deliveries of turbine components to the port, alternative ports of entry were not considered.

3.5.1.5 Ornithology

In accordance and in excess of best practice, three years of bird surveys were completed as part of the baseline EIA studies. These surveys commenced in 2021 and have been ongoing. The baseline surveys collated data on birds using the proposed development and surrounding areas. All flights were mapped and bird counts from field surveys were collated into reports covering the winter and breeding periods each year.

This baseline data and relevant consultation responses (refer to **Volume III, Appendix 1B**, Stakeholder Consultation & Responses of this EIAR) was then used in informing the design such as the addition of enhanced whooper swan foraging areas.

3.5.1.6 Soils and Geology

A scoping exercise was carried out to determine whether a detailed Peat Landslide Hazard and Risk Assessment was required for the proposed development. This scoping exercise reviewed whether peat was present onsite. No peat was mapped on the GSI maps for the proposed development. Site investigations found small patches of peat at depths of 0.25m-0.80m at the locations of Turbines 1, 2 & 4. The peat risk ranking for this site is zero therefore a Peat Stability Risk Assessment is not warranted for this site. There is no risk of instability of the site, access tracks, turbine bases or grid connection from peat. Site Investigation (SI) works were carried out by Northwest Geotech, a geotechnical engineering consultancy firm on the 6th and 9th August 2024. Further site investigation works were carried out by Malachy Walsh and Partners (MWP) during November 2024 and February 2025 to determine the geology and aggregate resource at various locations throughout the proposed development site. Ground types encountered and groundwater encountered during the SI were noted and used to inform the design process and construction of the proposed wind farm. The Site Investigation Findings are included in **Volume III**, **Appendix 8A** Northwest Geotech Ltd Ground Investigation Report and **Volume III**, **Appendix 8B** Trial Pit Logs of this EIAR.

3.5.1.7 Hydrology

All open water bodies adjacent to areas of proposed works, including settlement ponds, will be protected by fencing. A minimum 50m buffer to EPA mapped watercourses will be retained for construction works, except for crossings and other works.

3.5.1.8 Archaeology

As advised by the project archaeologist based on their significant professional experience, a minimum buffer exclusion zone of 20m was established around areas of Archaeological Importance to avoid any accidental damage during construction.

3.5.2 Identification & Mapping of Constraints & Facilitators

Once the key sensitive environmental constraints were identified, set back distances to constraints were applied using Geographical Information Systems (GIS). Constraint mapping was generated, which identified the most and least environmentally sensitive, or constrained, areas within the proposed development. This approach highlights potentially significant environmental impacts early on in the design process in order that they can be avoided, and if that is not possible, impacts reduced or mitigated. It also limits the area for the proposed development thereby limiting the number of turbines and associated infrastructure.

The constraint mapping documented and visually communicated the environmental constraints (e.g. sensitive habitat, water features) to the wind farm design team, thereby highlighting the optimum locations (areas with few or no constraints) for wind farm infrastructure. Watercourse and Archaeological Constraints within the wind farm site are shown in **Figure 3-4** and **Figure 3-5**. Constraint mapping was also cognisant of relevant consultation feedback, such as setback distance from dwellings, noise and shadow flicker.

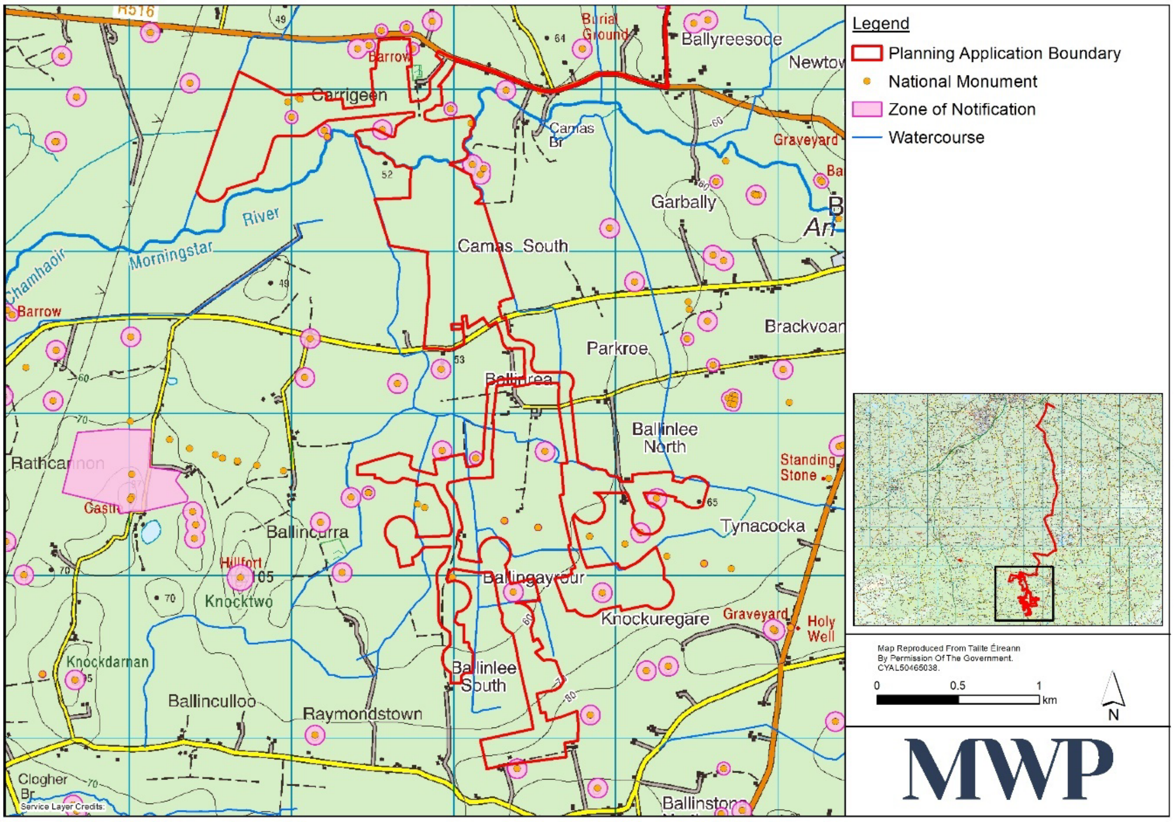

Figure 3-4: Watercourse and Archaeological Constraints within the Wind Farm Site

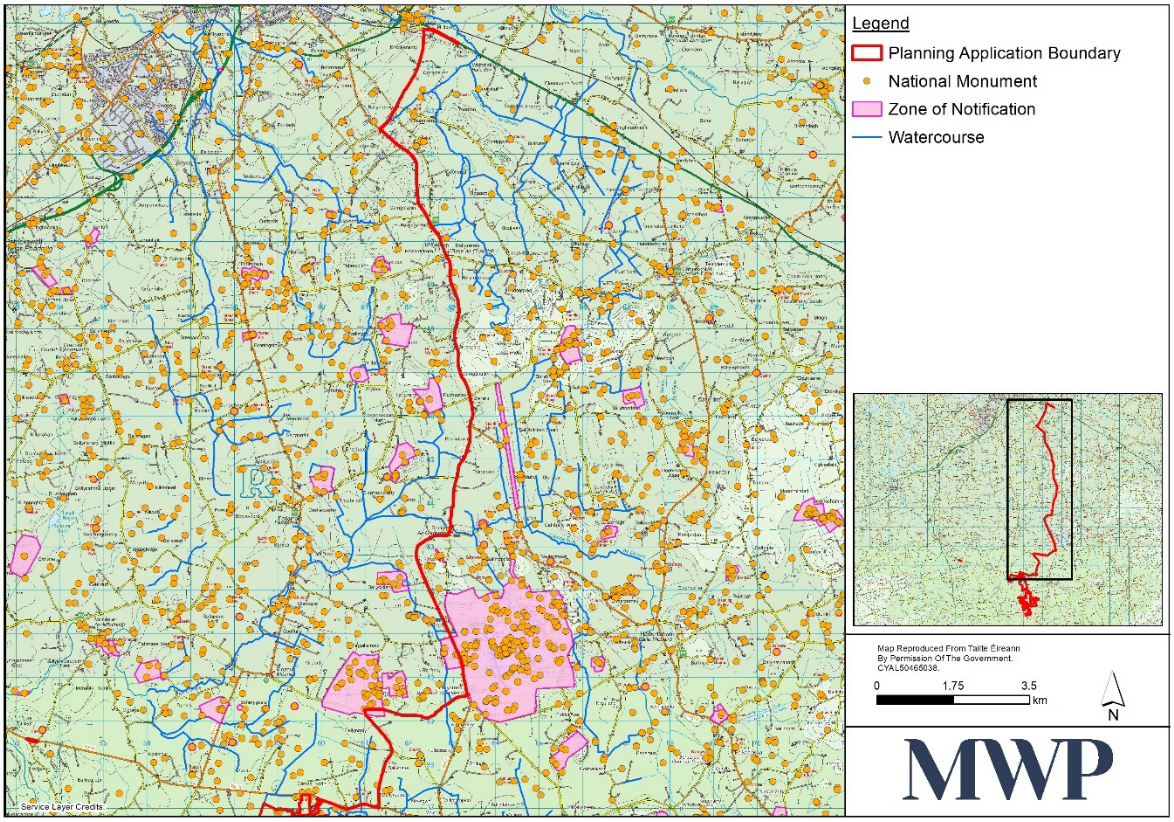

Figure 3-5: Watercourse and Archaeological Constraints within the Grid Route

Habitats identified as part of constraint mapping are outlined in **Figure 3-6**.

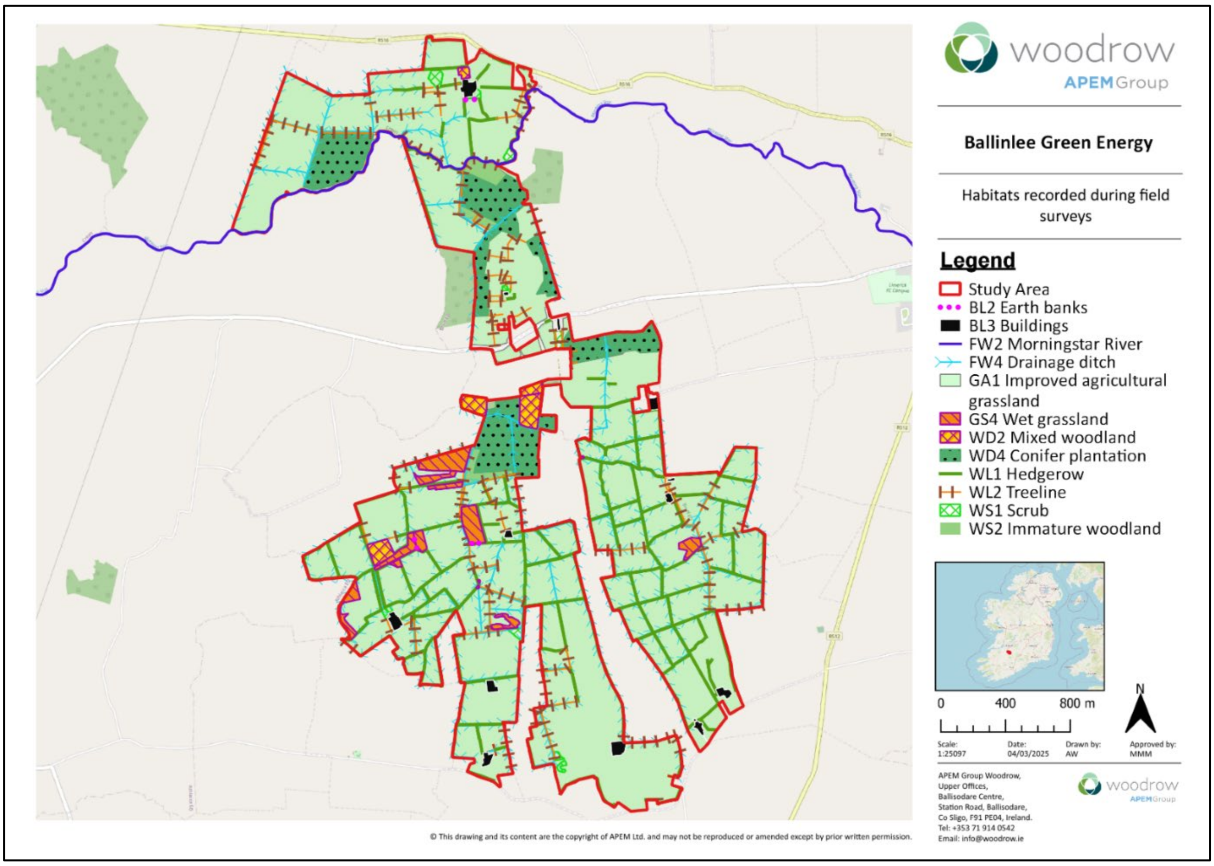

Figure 3-6: Habitats Identified

3.5.3 Preliminary Planning Stage Design

Following identification of all the environmental, technical and engineering constraints for the proposed development, a preliminary layout that fits with the remaining usable areas was developed. The layout included the preliminary internal track network and provisional locations for the electrical substation compound, permanent meteorological mast and material storage areas. The technical design criterion for the layout was to maximise the annual energy yield while maintaining the required set back distances between turbines. The preliminary design layout was then used as a basis for a more detailed site assessment on which the final detailed design would be developed (refer also to Volume II, Chapter 02 Description of the Proposed Development of this EIAR).

3.5.3.1 Turbine Siting

This EIAR has assessed a wind farm layout with a total of seventeen (17) no. Turbines, sixteen (16) No. Turbines which have a tip height of 160m and one (1) No. Turbine (T6) with a tip height of 150m. A number of alternative wind farm design layouts were considered on an iterative basis to arrive at the optimum wind farm layout. A comparison of the environmental effects of the design layouts facilitated the selection of the optimum wind farm layout (see Table 3-4). The presentation and consideration of the various reasonable alternatives investigated by the applicant is an important requirement of the EIA process. Alternative wind farm layouts and scales were fully considered in order to find the optimum design solution for the site with the least level of environmental impact.

The proposed development examined various turbine layout configurations applying habitat maps, water features, biodiversity impacts and residential receptors before choosing the current layout. Refer to **Section 3.6** for further details of the alternatives considered.

3.5.4 Detailed Planning Stage design

The detailed design of the wind farm was driven by a process of mitigation by avoidance as well as a principle of using existing infrastructure to the maximum possible extent. In many cases the relocation of a turbine, substation or internal access track was not straightforward because other turbines and access tracks also had to be moved so as to maintain the required set back distances between them and other technical and environmental constraints, buffers and set-backs.

In total the layout underwent four (4) iterations driven by engineering, environmental, technical and landowner considerations as the proposed development evolved. These were relatively minor geographically given the site constraints but required significant effort and input from the design team.

3.6 Alternatives Considered

This section outlines the main reasonable alternatives examined and considered during the proposed development design process and indicates the main environmental reasons for choosing the development as proposed. A comparison of the environmental effects on the alternatives considered is also provided.

The alternatives considered include the following:

- Reasonable Alternative Wind Farm Layout and Turbine Scale;
- Reasonable Alternative Grid Connection Methodologies; and
- Reasonable Alternative Construction Methodologies.

3.6.1 Alternative Wind Farm Layout and Turbine Scale

In total there were four (4) iterations considered before determining the optimum layout with minimal environmental impact. The final design layout was primarily influenced by physical and environmental sensitivities. The iterations are listed in **Table 3-4** which outlines the design improvement as the layout, size and scale evolved. As outlined in the European Commission’s 2017 Guidance, alternatives provide an opportunity to change the design in order to minimise the project’s significant effects on the environment. Preventative action is the most effective way to avoid potential negative environmental effects and this avoidance has been achieved through the design process and the consideration of alternatives and through the review of the proposed development design to minimise environmental effects.

Table 3-4: Design Evolution and Iterations

Iteration	Description of Iteration	Reason for Change	Design Improvement
Initial	2 Areas: Camas South 7 No. turbines & Ballinlee 11 No. turbines. Up to 200m tip height (**Figure 3-7**).	N/A	N/A
1	Camas South: T2 & T5 dropped. T6 repositioned to accommodate flight paths and foraging for Swans (**Figure 3-8**).	Swan population in Camas South.	Swan enhancement areas added to enhance areas for swan usage.
2	Reposition of Ballinlee T8, T9, T13, T14, T17 (**Figure 3-9**).	Turbines repositioned to allow for GNI TX Transmission Pipeline. Smaller Turbine size to facilitate revised setback distances.	Outside setback distance of the pipeline.
3	Reposition of Camas South T1, T3, T4, T5, T7 (Renumbered T1 to T5) (**Figure 3-10**).	Greater setback from Swan Habitat areas. T5 moved to edge of Forestry. Reduction of Turbine Size 160m Tip Height which reduces visual impacts.	Reduced risk to swans and less forestry removal. Greater turbine separation. Reduced Turbine size.
4	Full site now known as Ballinlee WF and fully renumbered. New Tip Height of 160m except for T6 - 150m Tip Height (**Figures 3-11, 3-12**).	T1, T2, T3 realigned for Swans, T6 moved and Tip Height reduced to accommodate falling distance to Substation. T7, T8, T9, T10 moved for access track alignment. Reduced turbine height means revised house buffer can be used. This allows new Turbine T11. T12 moved to revised house buffer, also affects T13, T15, T17.	Reduced risk to swans and less forestry removal. Greater turbine separation. Reduced turbine size. Less hedgerow removal and better access track lay out and alignment.

Figure 3-7 to **Figure 3-11** outlines the various iterations and design changes.

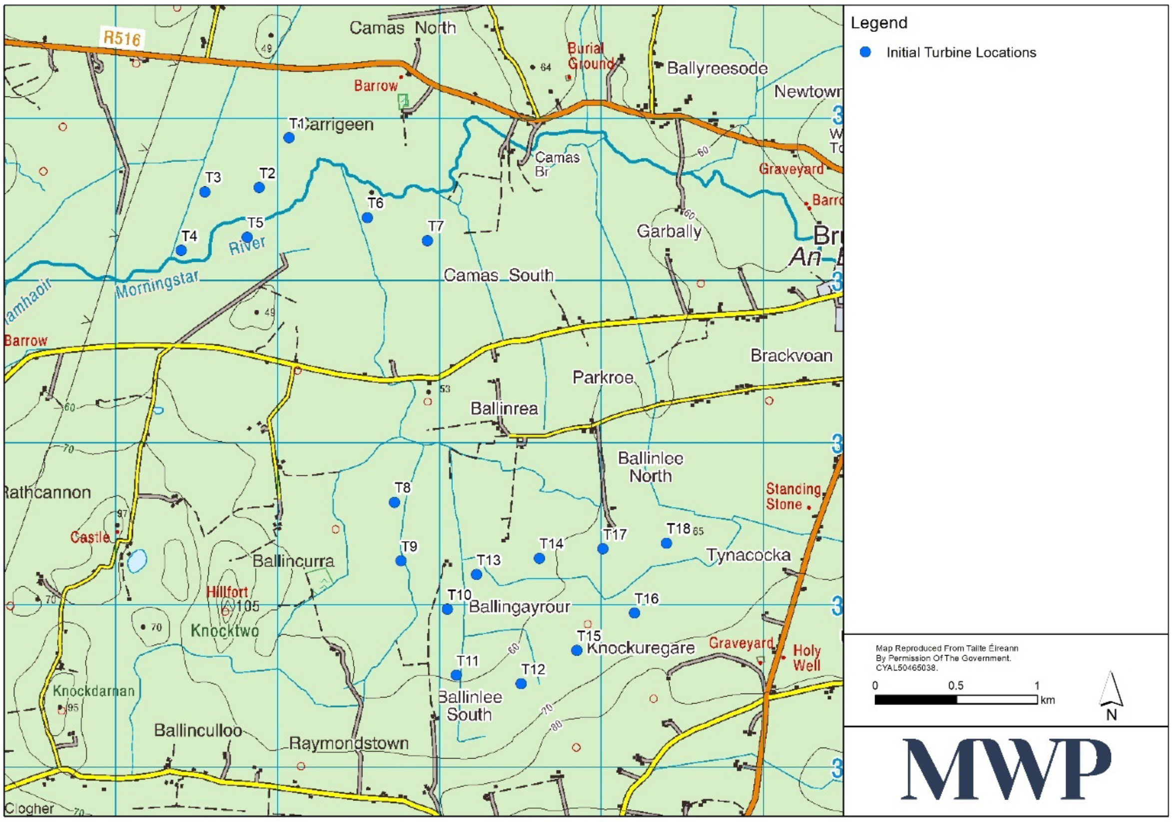

Figure 3-7: Initial Layout - 2 Areas: Camas South 7 No. turbines & Ballinlee 11 No. turbines. Up to 200m tip height

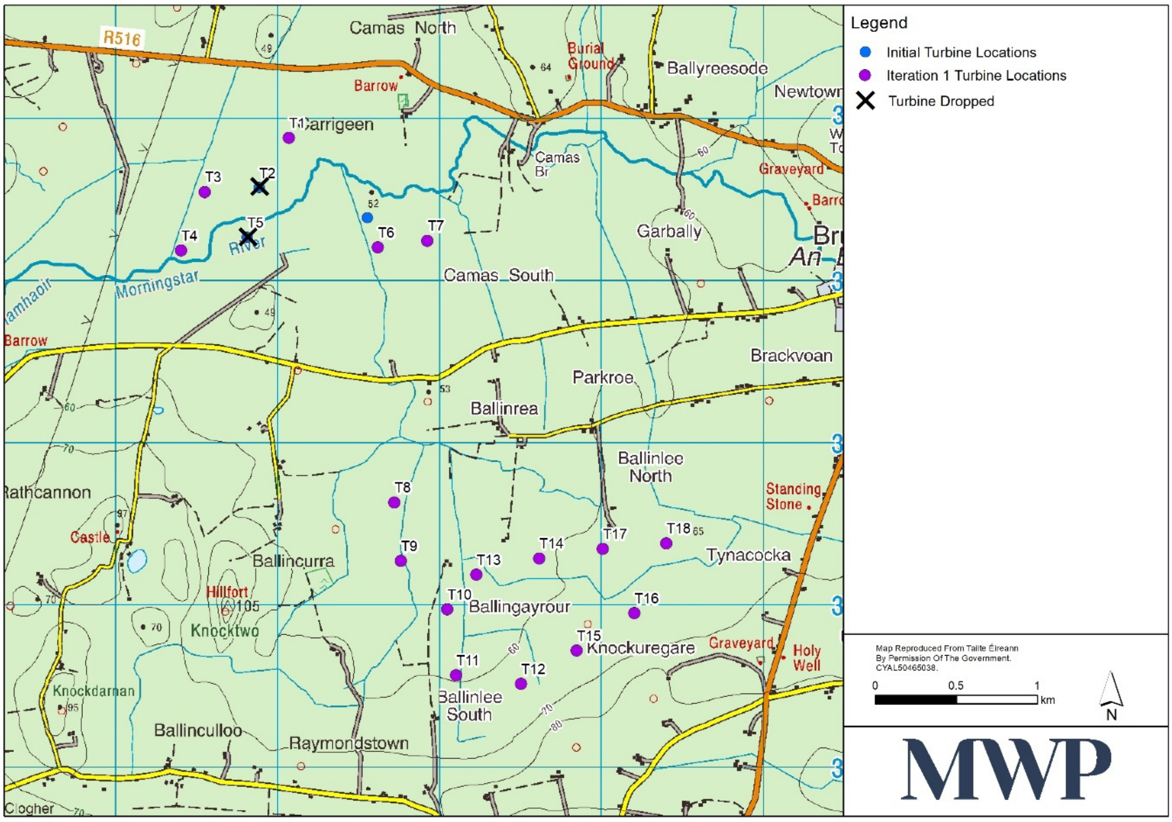

Figure 3-8: Iteration 1 – T2 & T5 dropped in Camas South. T6 repositioned to accommodate flight paths and foraging for Whooper Swans

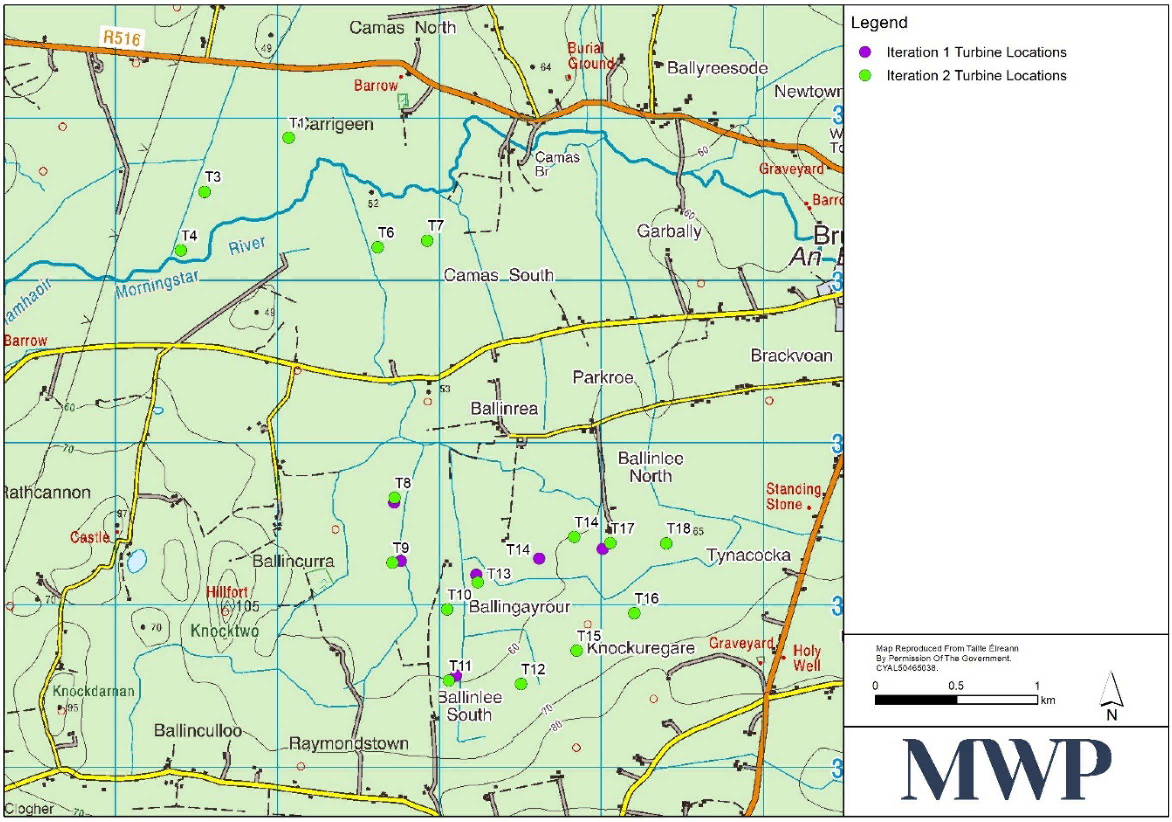

Figure 3-9: Iteration 2 – Reposition of Ballinlee T8, T9, T13, T14, T11, T17

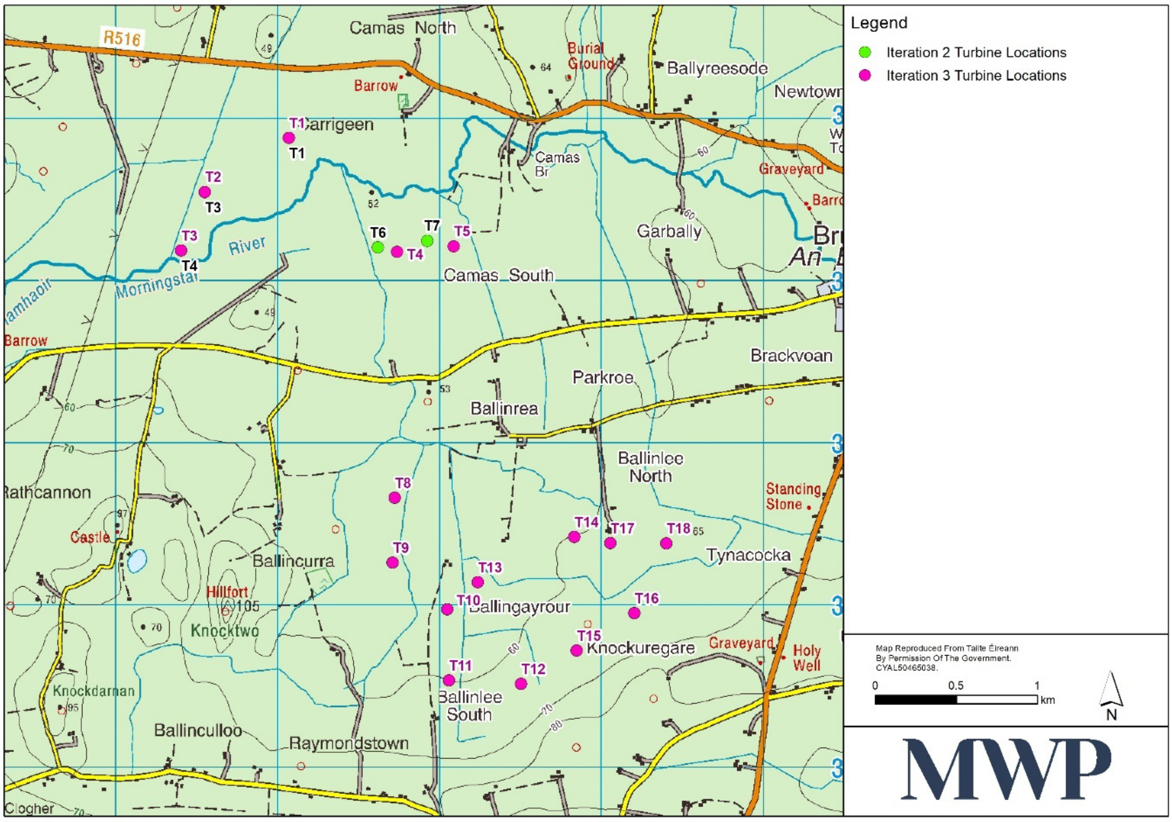

Figure 3-10: Iteration 3 – Reposition of Camas South T1, T3, T4, T5, T7 (Renumbered T1 to T5)

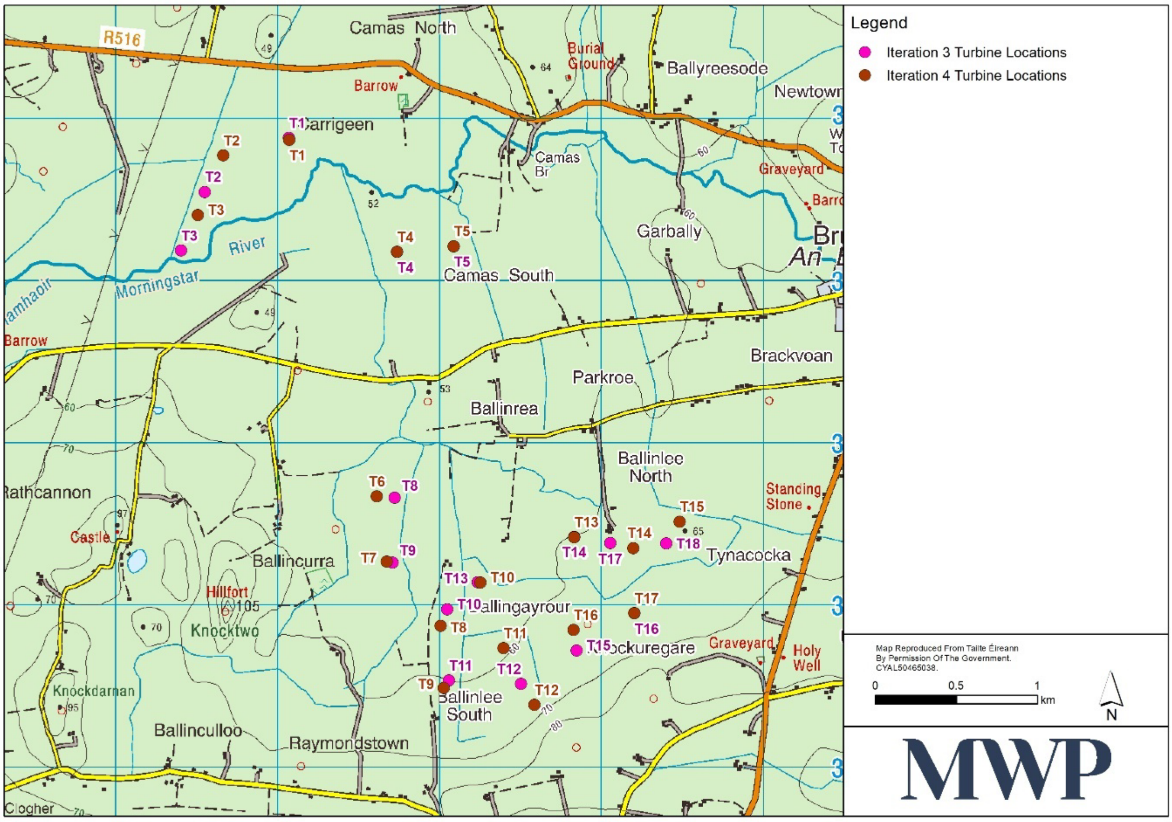

Figure 3-11: Iteration 4 – Full site now known as Ballinlee Windfarm and fully renumbered. New tip height of 160m except for T6 with a 150m tip height

The final layout shown in Figure 3-12 represents the most appropriate design for the site conditions, following an iterative approach of design optimization by the engineering and environmental members of the project team. This approach took account of all emerging baseline environmental information during the EIA process, and therefore, the optimum wind farm layout for the development is proposed. Due to landowner constraints, it was not possible to construct an access track linking T11 and T16. Table 3-5 outlines a comparison of site conditions and environmental effects in relation to the design improvements from initial to final design.

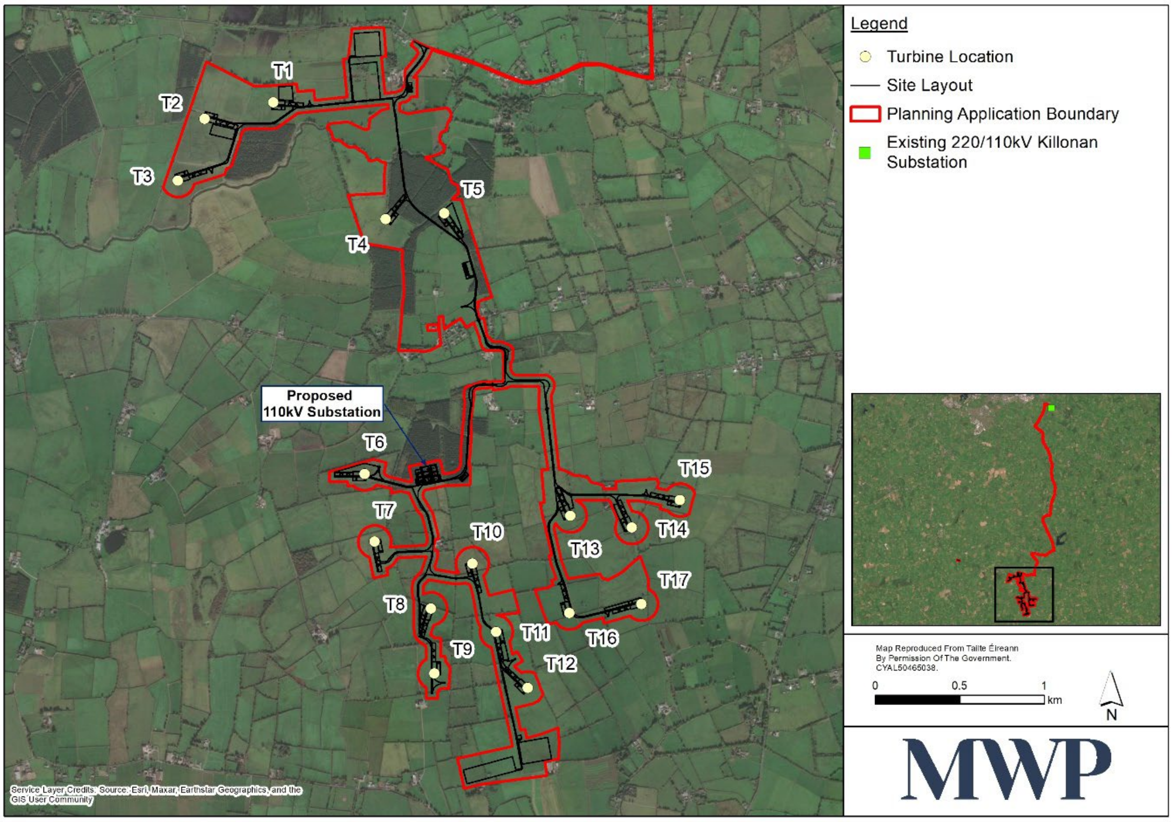

Figure 3-12: Final Site Layout

Table 3-5: Comparison of Environmental Effects

Environmental Factor	Initial Design	Final Design
Population and Human Health	18 No. turbines with a tip height of up to 200m.	Reduction in number of turbines to 17 No. turbines, reduction in height of turbines resulting in increased setback from dwellings.
Biodiversity	Swan Population located to the north of the site.	Swan enhancement area identified within the site.
Air and Climate	18 No. turbines with a tip height would produce more renewable electricity and provide a greater reduction of carbon emissions.	17 No. turbines results in a slight reduction of renewable electricity however, the embodied carbon requirements would also be reduced during construction.
Landscape and Visual	18 No. turbines with a tip height of up to 200m visible in certain areas throughout the landscape.	Reduced number of turbines to 17 No. turbines with a reduced tip height of up to 160m, thus reducing visual effect.

Environmental Factor	Initial Design	Final Design
Water	A minimum 50m buffer to EPA watercourses, with the exception of crossings and other works.	A minimum 50m buffer to EPA watercourses will be retained for construction works, with the exception of crossings and other works.
Land and Soils	Geological hazards at the wind farm site including features like faults, and karst areas were avoided as far as possible to minimise the risk.	Geological hazards at the wind farm site including features like faults, and karst areas were avoided as far as possible to minimise the risk.
Noise	Greater number of turbines and greater tip height, potential for noise impact.	Number of turbines reduced, increased setback from dwellings due to reduced turbine height, potential for noise impact reduced.
Cultural Heritage	No works within archaeological buffer.	No works within archaeological buffer.
Material Assets	Construction traffic utilising local public road to entrance.	Construction traffic utilising local public road to entrance.

3.6.2 Alternative Grid Connection Methodologies

Various grid connection options were assessed in relation to connecting the proposed development to the National Electricity Grid (NEG). A ranking of the various options available was completed.

3.6.2.1 Alternative Substation and Grid Connection Infrastructure

The proposed development is located within close proximity to existing and consented transmission infrastructure and has a viable connection to the National Grid.

Potential grid connection options to the existing substations north of the proposed development were examined. These are outlined in **Table 3-6** and displayed in **Figure 3-13**.

Table 3-6: Comparison of Environmental Effects

Option	Description	UGL/OHL	Distance (km)
1	Connection to Killonan 220/110kV substation	UGL	27.6km
2	Connection to Killonan 220/110kV substation	UGL	27km

Option	Description	UGL/OHL	Distance (km)
3	Connection to Limerick 110kV substation	UGL	25km

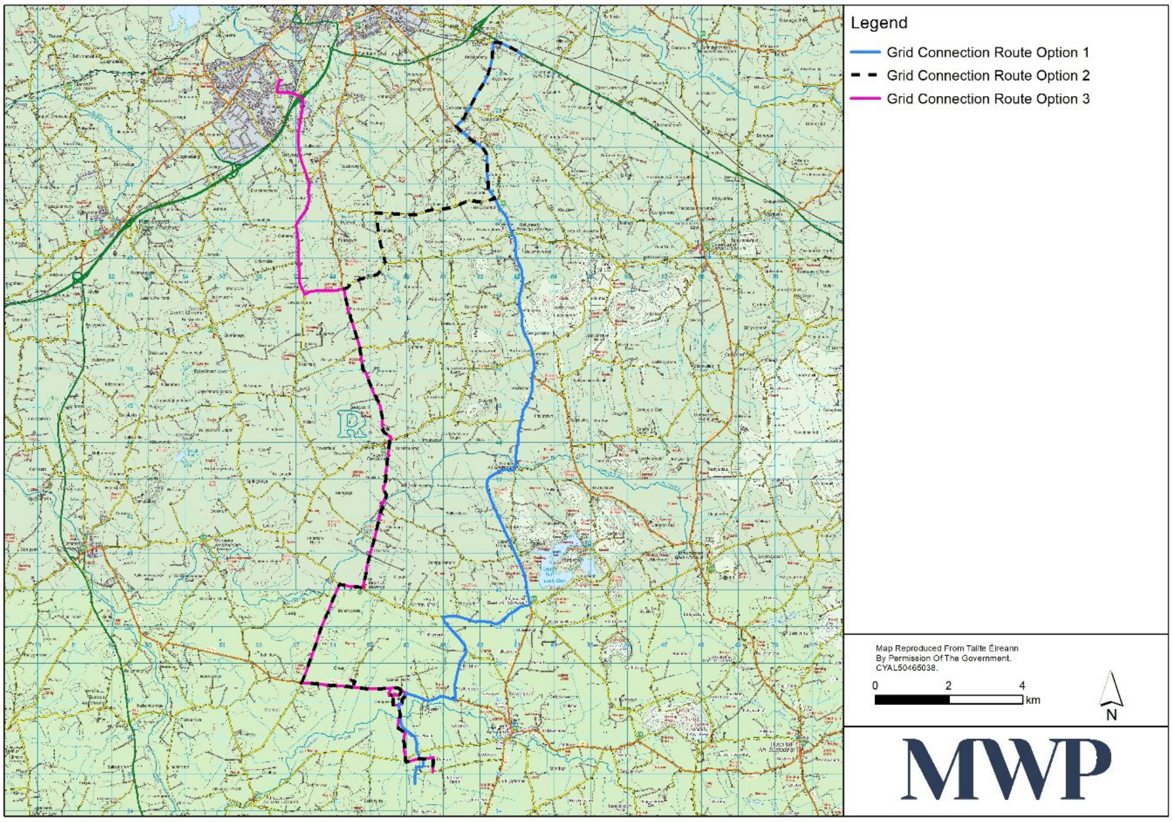

Figure 3-13: Grid Connection Options Considered

Based on the various connection methods identified, these were ranked in relation to the most favourable options (Table 3-7).

Table 3-7: Grid Connection Options Ranking

Rank	Description
1	Connection to 220/110kV Killonan Substation (Option 1)
2	Connection to 220/110kV Killonan Substation (Option 2)
3	Connection to Limerick 110kV Substation (Option 3)

Ultimately, Option 1 consisting on an underground route to the existing 220/110kV Killonan substation within the curtilage of the public road for the majority of the route was selected for the following reasons:

- Reduced traffic disruptions to Limerick City;
- No effect on protected structures as a result of utilising existing public road for the majority of the grid connection route;
- Reduced number of water crossings.

Also, the effect to Ornithology and Biodiversity is reduced due to the works being undertaken within the public road. A comparison of potential environmental effects associated with the three top ranking options are outlined in **Table 3-8.**

Table 3-8: Comparison of Environmental Effects of Grid Connection options

Environmental Factor	Grid Connection to 220/110kV Killonan Substation (Option 1)	Grid Connection to 220/110kV Killonan Substation (Option 2)	Grid Connection to Limerick 110kV Substation (Option 3)
Population and Human Health	Traffic disruptions during the construction phase.	Traffic disruption during the construction phase.	Traffic disruption during the construction phase.
Biodiversity	No effect due to works carried out on the public road.	No effect due to works carried out on the public road.	No effect due to works carried out on the public road.
Ornithology	No effect due to works occurring on the public road.	No effect due to works occurring on the public road.	No effect due to works occurring on the public road.
Air and Climate	Emissions from construction vehicles.	Emissions from construction vehicles.	Emissions from construction vehicles.
Lands and Soils	Temporary removal of overburden during laying of cables.	Temporary removal of overburden during laying of cables.	Temporary removal of overburden during laying of cables.
Water	Total of 4 No. EPA water crossings.	Total of 14 No. water crossings.	Total of 15 No. water crossings.
Noise	Construction phase noise.	Construction phase noise.	Construction phase noise.
Landscape	No effect as works occurring underground on the public road.	No effect as works occurring underground on the public road.	No effect as works occurring underground on the public road.
Cultural Heritage	No effect as no cultural heritage features on route.	No effect as no cultural heritage features on route.	Effect on protected structure in Glenogra.
Shadow Flicker	No effect as only relevant to wind turbines.	No effect as only relevant to wind turbines.	No effect as only relevant to wind turbines.

Environmental Factor	Grid Connection to 220/110kV Killonan Substation (Option 1)	Grid Connection to 220/110kV Killonan Substation (Option 2)	Grid Connection to Limerick 110kV Substation (Option 3)
Material Assets	Additional traffic locally during construction phase.	Additional traffic locally during construction phase.	Additional traffic locally during construction phase.

3.6.3 Alternative Construction Methodology

The proposed construction methods are informed and identified by desktop studies, site walkovers and input from ecological and engineering teams. Construction method alternatives were examined for internal access tracks and are discussed below.

3.6.3.1 Internal Access Tracks

The primary objective when designing the new internal access tracks was to utilise existing tracks where possible and to locate infrastructure where ground conditions are suitable. Maximum use where practicable has been made of existing tracks, however the proposed development, will require new access tracks to the majority of the turbines. The proposed development will use existing tracks and approximately 10.8km of new track will be constructed within the proposed development.

New excavated tracks will be constructed using stone aggregate placed over a layer of geogrid, where required, after all organic and soft subsoil material is excavated to formation level. Geotextile material, used to separate the access track building material from the subsoil, may also be laid at formation level.

Depending on ground conditions encountered, new tracks will be constructed as excavated or floated design. The environmental effects for both methods for excavated or floated design tracks are predominantly neutral across environmental factors. Refer to **Table 3-9** for the comparison of construction track methods.

Table 3-9: Comparison of Environmental Effects of Internal Track Construction Methods

Environmental Factor	Utilising Existing Tracks	Construction of new tracks – Excavated	Construction of new tracks – Floated
Population and Human Health	No effect	Additional traffic during construction phase, import of materials.	Additional traffic during construction phase, import of materials.
Biodiversity	No effect	Requirement for localised hedgerow removal.	Requirement for localised hedgerow removal.
Ornithology	No effect	No effect.	No effect.
Air and Climate	No effect	Slightly more emissions during construction phase as a result of excavation to formation level.	Reduced emissions during construction phase.
Lands and Soils	No effect	Excavation to formation level.	Less compaction.

Environmental Factor	Utilising Existing Tracks	Construction of new tracks – Excavated	Construction of new tracks – Floated
Water	No effect	Increased surface runoff from new tracks installed at existing ground levels.	Increased surface runoff and the raised profile of the access track may act as an obstruction barrier to surface water run off with the potential to create ponding.
Noise	No effect	Construction phase noise.	Construction phase noise.
Landscape	No effect	Screened by existing vegetation will allow for no visual impact on surrounding receptors.	Screened by existing vegetation will allow for no visual impact on surrounding receptors.
Cultural Heritage	No effect	No effect.	No effect.
Shadow Flicker	No effect	No effect.	No effect.
Material Assets	Minimal amount of traffic during construction phase as minimal works required.	Most amount of traffic during construction phase.	Medium amount of traffic during construction phase.

3.6.3.2 Deliveries of Materials from Nearby Quarries

In order to facilitate the construction of the proposed development, some material will need to be imported from nearby quarries. The quarries that could potentially provide stone and concrete for the proposed development area:

- Joseph Hogan Roadstone.
- Liam Lynch Quarries Ltd.
- Costello Quarry Products.
- W.M. McAuliffe Ltd.
- McGrath Concrete.
- Ballyorgan Quarries.
- Leahys Stone.
- Gleeson Concrete.

There will also be use of onsite borrow pits which eliminates the need to transport large volumes of construction material along the public road network to the proposed development. A comparison of the potential environmental effects of obtaining stone material offsite and using onsite borrow pits is outlined in **Table 3-10**.

The preferred alternative is to develop and utilise on site aggregate resources over importation where feasible due to:

- The advantages of reduced traffic volumes on the public road network and associated reduced public disruption, noise, and air quality effects;
- The advantages that an on-site borrow pit provides suitable repositories for storage of surplus excavated soils.

Table 3-10: Comparison of Environmental Effects of Material Sourcing

Environmental Factor	Onsite Borrow Pits	Imported Material
Population and Human Health	Volume of traffic on public road network minimised.	Additional traffic during construction phase, import of materials.
Biodiversity	Larger development footprint would result in larger amounts of habitat loss.	Material sourced from regulated, licenced quarry – no loss of on-site habitat.
Ornithology	Potential for disturbance and displacement of ornithology species.	Material sourced from regulated, licenced quarry – no impact on onsite ornithology.
Air and Climate	Potential for additional dust emissions on site due to borrow pit excavation.	Increased effect due to vehicle emissions.
Lands and Soils	Potential for increased impact on land and soils due to excavation.	No effect on lands and soils of development site.
Water	A drainage plan for an onsite borrow pit would be required. Potential for impacts on water quality.	No effect.
Noise	Potential for increased noise and vibration impacts on receptors in vicinity of development.	Off-site noise emissions including traffic.
Landscape	No effect as borrow pit would be reinstated following use.	No effect.
Cultural Heritage	Larger development footprint, increasing the potential for impacts on sub-surface archaeology.	No effect.
Shadow Flicker	No effect.	No effect.
Material Assets	Less impact on public road network.	Additional traffic during construction phase.

3.7 Do Nothing Scenario

Should the proposed development not be realised, the development will not contribute to Ireland's renewable energy infrastructure and it will not contribute to Ireland's renewable energy targets. In a do nothing alternative, this proposed development would not contribute to Ireland's commitment of reducing greenhouse gas emissions by 51% by 2030 as set out in the Climate Action Plan 2025. An opportunity to significantly offset CO_2 emissions will be lost. The proposed development will result in a long term, significant, positive effect in contributing to Ireland's renewable energy targets and offsetting CO_2 emissions.

A do-nothing scenario would result in the continuation of agriculture operations at the entire site, in the absence of wind farm infrastructure in parts of the site. In the do-nothing scenario, no new development will take place, and the present character of the land-use will remain with ongoing agricultural activities.

3.8 Conclusion

The proposed development design process and reasonable alternatives were completed with reference to the Draft Revised Wind Energy Development Guidelines 2019, Wind Energy Development Guidelines 2006, EIA Directive, the EPA EIAR Guidelines 2022 and the EU Guidance Document 2017.

The proposed development has been designed to minimise any potential environmental impacts and to maximise wind potential on site.

Alternatives examined included alternative site locations, alternative site layouts, alternative turbine scales, alternative grid connections and alternative construction methods.

The final site layout was determined based on multi-discipline inputs and consideration of biodiversity, land and soils, archaeology, hydrology, landscape, and engineering constraints. The development as proposed is the preferred option as it results in the least effects on resources and receptors, while meeting the project objectives of a large-scale renewable wind energy development.

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