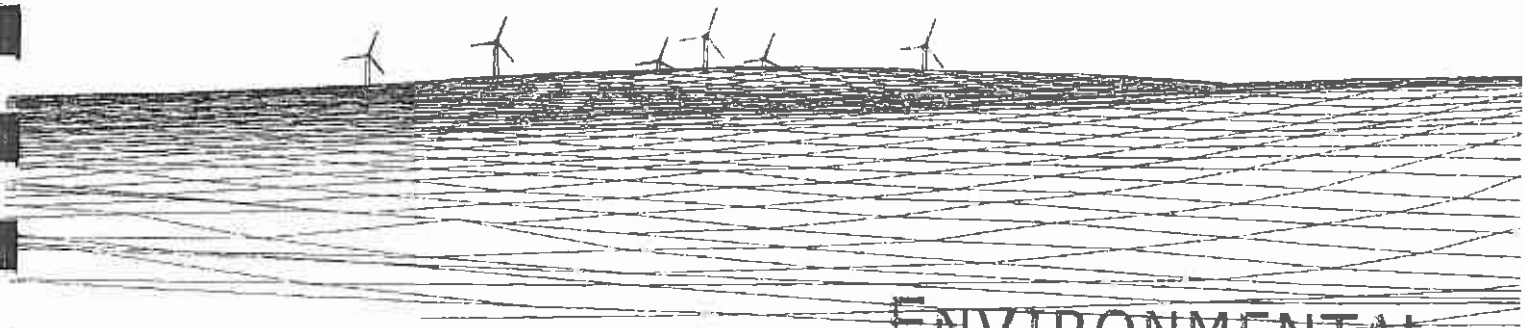
BALLYMARTIN NORTH
WIND FARM



ENVIRONMENTAL IMPACT STATEMENT

Table of Contents

Non-technical summary 4

Introduction 6
- Personnel involved in this Environmental Impact Statement 6
- Introduction to wind energy 6
- Description of the proposed development 7
- The Developer 8
- Statutory Issues 8

Policy Context 9
- International 9
- Kyoto Protocol 10
- EU Energy Policy 10
- Irish energy market 10
- Government Policy 11
- Kilkenny County Development Plan 2008-2014 12

Public Surveys of Wind Energy 13
- Sustainable Energy Ireland 2005 13
- IWEA Public Attitude Survey 1999 14
- BWEA Public Attitude Survey 2005 14

Wind Farm Site Selection 15
- Suitable Characteristics of the Ballymartin North Site 15

Landscape & Visibility 17
- The existing environment 17
- The predicted effects of the proposed project 17
- Measures to lessen adverse effects 21

Sound Issues 22
- The existing environment 22
- The predicted effects of the proposed project 22
- Measures to lessen adverse effects 23

Telecommunications 25
- Existing environment 25
- Predicted effects of the proposed project 25
- Measures to lessen adverse effects 25

Other Effects on Humans 26
- Site transport access 26
- Shadow flicker 27
- Electromagnetic fields 28
- Hazard from blade disintegration 28
- Flashing 28
- Counter rotation 28
- Decommissioning of the wind farm 28

Effects on Ecological Condition & Functioning 29
- Introduction 29
- Flora & Habitats 30
- Fauna 31

Effects on Archaeological Remains 38
- Assessment Methodology 38
- Archaeological Impact Statement 47
- Recommended Archaeological Mitigation Measures 47
- Bibliography 48

Effects on Bedrock & Overburden 49

The existing environment 49
The predicted effects of the proposed project 49
Measures to lessen adverse effects 49
Effects on Water Quality 51
The existing environment 51
The potential effects of the proposed project 51
Measures to lessen adverse effects 51
Effects on Air & Climate 52
The existing environment 52
The predicted effects of the proposed project 52
Measures to lessen adverse effects 52
Effects on Material Assets 53
Aviation 53
Effects on Cultural Heritage 53
Interaction of Foregoing Effects 53
Reference List 54

Non-technical summary

Wind turbines are designed to harness the kinetic energy in wind and convert it into electrical energy and a wind farm is an optimised array of wind turbines. Modern wind turbines consist of a tubular steel tower 50m-80m high on which a nacelle is placed containing the electrical generator. Three fibreglass blades, each of which may be up to 45m in length and propelled by the prevailing wind, drive the generator. The combined power from the turbine array is exported to the national grid.

The proposed wind energy project at Ballymartin North will involve the construction and operation of three wind turbines, each with a tubular steel tower of 79m in height and a rotor blade diameter of 82m.

This EIS will consider the cumulative environmental impact of this Ballymartin North project together with a separate but adjacent 3 turbine project with the same turbine specifications (Kilkenny County Council Ref. P.07/2140). The combined 6 turbine wind farm would have the potential to produce up to 14.0MW of electrical energy, sufficient to power the domestic needs of approximately 10,000 dwellings.

The Ballymartin North site was chosen due to a number of factors:

- Wind speeds on the site have indicative mean annual values up to 7.25 metres per second at 79m above base elevation which is an economically viable wind asset.
- The proximity of the site to a previously approved wind farm immediately adjacent to the proposed site (Kilkenny County Council Ref. P.07/2140) will negate the requirement for a separate dedicated power line as the approved sub-station on the adjacent site will be utilised to export the power to the national grid.
- Kilkenny County Council's County Development Plan 2008-2014 incorporates the 'Wind Energy Development Strategy 2007' which states in Section 8: "*it is Council Policy to allow development in all areas highlighted as 'Acceptable in Principle*." The proposed wind farm site at Ballymartin North is located in the south-east region of Co. Kilkenny within a region in which wind energy development is Acceptable in Principle (Map15). Also, Section 8 of Wind Energy Development Strategy 2007states "*all windfarm sites within this Strategy Area will be intensified in the future by a) taller turbines with larger swept areas, b) higher densities and c) more advanced technology with higher efficiencies of energy capture*." The proposed three turbine clustered development at Ballymartin North satisfies all the stated strategy criteria.
- The proposed wind farm site is not located within or adjacent to a designated National Heritage Area (NHA; Wildlife Amendment Act, 2000), a Special Protection Area (SPA; Directive 79/409/EEC) or a Special Area of Conservation (SAC; Directive 79/409/EEC).
- The proposed site is not located within or adjacent to a designated Area of High Amenity in Kilkenny County Council's County Development Plan 2008-2014.
- The site is dominated by an improved grassland habitat and is currently grazed, therefore:
  - no rare or vulnerable ecological habitat will be disturbed by the wind farm
  - no archaeological artefact will be disturbed by the wind farm
  - no adverse effect on land usage: farming activity will be able to continue
- Regional site access is served by the existing primary and regional road network and local third class roads.

The foremost environmental effect of the operation of the combined six turbine wind farm will be the visibility from the surrounding landscape. With no additional local screening effects, approximately 65% the surrounding landscape will have no view of the turbines' nacelle or half-blade. A summary of the theoretical landscape visibility based on nacelle visibility is as follows:

Visibility	Area km^2	Percentage
Ballymartin North 3T 79m hub	60.87	3.79
Ballymartin 3T 79m hub (P.07/2140)	13.67	0.85
Both	487.66	30.40
None	1041.81	64.95

The effect of broadband sound emitted by the turbines on dwellings has been modelled using a 79m hub turbine with a broadband power output of 103.4dB for the three Ballymartin North turbines and using an approved (PL.10.208178) level of 101.5dB for the three turbines on the adjacent property. The modelling demonstrates that no dwellings will be located within the 45dB(A) level, an appropriate level for a rural area with a background noise level above 30dB(A). Any sound output will be minimised by operating professionally maintained, new turbines.

A desktop and field ecological study has shown that improved grassland and species-poor hedgerow are the dominant habitats on the site. Hen Harrier, listed for protection under Annex I of the EU Birds Directive, nest within 2.0km of the proposed site but the potential long-term risk to the local raptor population is considered to be minor. Any potential risk to avifauna from roosting on turbines will be reduced by the use of tubular towers and generator housings unsuitable for roosting. No vulnerable mammal species was recorded on site.

A desktop and field archaeological study has identified a hitherto unrecorded and unverified standing stone in the western parcel of the proposed landholding. The excavation and construction of all site infrastructure will be professionally monitored to ensure compliance with the recommended mitigation measure of a 50m buffer-zone around this artefact and due to the potential of uncovering sub-surface artefacts.

The on-site sedimentary bedrock is an abundant regional rock type and its minor on-site excavation is not an unacceptable environmental effect. Improved grassland soil structure, low mean site gradients and shallow soil depths indicate that the development of wind turbine infrastructure will not cause any slope stability concerns during the construction phase.

The existing high quality surface water in the Ballymartin North area will be strictly protected by ensuring that no sediment-laden water reaches any nearby watercourse. No streams will be traversed by any site infrastructure. The risk to the local aquifer resource is considered low.

The use of the public access routes for construction traffic will be confined to, on average, two to three vehicle movements per day over the three to four month construction period.

TV broadcast signals and data telecommunications in the region are robust and will not be affected.

Introduction

Personnel involved in this Environmental Impact Statement

EIS co-ordination	Mr. John Forde, B.Sc., M.Sc., Windscene Consulting Monument Rd., Menlo, Galway City 086.8568244 ; info@windsceneconsulting.com
Ecology	Mr. Ciaran Ryan, 62 Hawthorn Ave., Killarney, Co. Kerry 086.8657176 ; ciaranryan5@hotmail.com Cork Ecology, Long Strand, Castlefreke, Clonakilty, Co. Cork 023.40665 ; info@corkecology.net
Archaeology	Mr. Cóilín Ó Drisceoil, Kilkenny Archaeology Ltd., Unit 11, Abbey Business Centre, Abbey Street, Kilkenny 056.7752200; kilkennyarchaeology@gmail.com
Visual & Landscape **Sound Effects** **Other**	Mr. John Forde, B.Sc., M.Sc., Windscene Consulting Monument Rd., Menlo, Galway City 086.8568244 ; info@windsceneconsulting.com

Introduction to wind energy

In the last 40 years, wind has been recognised as a vast, largely untapped, emission-less and renewable energy resource. Ireland, being on the European Atlantic seaboard, is regarded as possessing *the* best wind resource in Europe. This resource is very substantial and, if harnessed efficiently, is capable of providing a significant, non-polluting percentage of our total energy supply in the near future.

Such a resource is commercially harnessed by using large-scale wind turbines that consist of electrical generators driven by blades. This assembly of generator and blades is placed on top of a tapering tubular steel tower approximately 60m-80m high. The generator and its housing (nacelle) is placed at the top of the tower (hub height), while the rotor blades that drive the generator may be 30m-45m in length (Figure 1). Typically, the blades revolve 15-20 times a minute and a modern large turbine would produce 1000-3000 kilowatts (1.0-3.0MW) of electricity in a moderate wind.

The average Irish home uses about 4,600kWh of electricity per year. In Irish conditions, a 1MW wind turbine has the potential to produce in excess of 3 million units of electricity - sufficient to power the average domestic usage in approximately 650 homes.

Description of the proposed development

General

The proposed site is located in the townland of Ballymartin, 5.1km northeast of Mullinavat with a site-centre grid co-ordinate of 260800E, 127000N. The site has an average elevation of 215m with improved grass pasture being the primary land use. Indicative average wind speeds on the site are between 7.8–8.1 metres per second. Figure 2 shows the regional setting of the site in relation to regional population centres and roads in the immediate vicinity of the site.

It is proposed to construct three wind turbines on the site together with ancillary service roadways and crane hardstanding:

ID	Easting	Northing	Elevation
T1	260684	127306	216m
T2	260934	127115	220m
T3	260742	126889	205m
Anemometer	260720	127360	219m
Sub-station	260967	126832	210m

The positioning of the wind turbines is dictated primarily by the topography of the available site while, at the same time, minimising potential visual and environmental impacts and optimising the harnessing of the wind resource. Figure 3 shows the proposed access trackway, hardstanding and turbine placement.

Construction

The construction of a wind farm requires the construction of access tracks to the turbine and hardstanding locations. Once access to the turbine sites is completed, excavation and construction of the turbine foundations commences. All related electrical works are carried out at the same time as the erection and installation of the turbines. Electrical transformers for each turbine are located within the base of each turbine tower.

Connection to the National Grid

All on-site electrical infrastructure will be ducted underground. It is envisaged that the wind farm will have a connection to the national electrical grid network at the approved adjacent 3 turbine wind energy project which was granted An Bórd Pleanála approval in 2004 (Kilkenny County Council Ref. P.07/2140).

Wind turbine characteristics

New wind turbines made by a world leading manufacturer, such as Enercon, Siemens, GE, Nordex or Vestas, will be used in this project. Figure 1 gives information about one the most efficient and grid compliant turbine models on the Irish market to date, the Enercon 2.3MW E82 wind turbine.

Note: This project is based on the operation of wind turbines with a maximum hub height of 79m and a maximum rotor diameter of 82m. The choice of turbine make & model will be made on commercial grounds after a tendering process and will be agreed with the Planning Authority prior to construction.

The Developer

Ballymartin North Wind Farm is being proposed by Mr. Richard Walshe, The Church, Tullaroan.

Statutory Issues

Landscape Designations

The Ballymartin North site is not located in a designated National Heritage Area (NHA; Wildlife Amendment Act, 2000), a Special Protection Area (SPA; Directive 79/409/EEC) or a Special Area of Conservation (SAC; Directive 79/409/EEC).

Appendix D of the Kilkenny County Development Plan 2008-2012 defines designated Views and Prospects. The Ballymartin North site does not fall within the viewshed or compromise any designated Views and Prospects.

Requirements

The EU Directive 97/11/EC is transposed as The European Communities (Environmental Impact Assessment) (Amendment) Regulations, 1999 (S.I. No. 93 of 1999) and in Part 2 of the First Schedule, item (i) lists: "*Installations for the harnessing of wind power for energy production (wind farms) with more than 5 turbines or having a total output greater than 5MW.*" The Statutory Instrument requires that an EIS be submitted in conjunction with any planning application for a wind farm with more than 5MW installed capacity.

Structure of this Environmental Impact Statement

An Environmental Impact Statement (EIS) is defined in S.I. No 349 of 1989 (Art. 3 (1)) as: "*A statement of the effects, if any, which proposed development, if carried out, would have on the environment*". This EIS has been structured according to guidelines published by the Environmental Protection Agency (2002). All potential environmental effects are considered under the following headings:

1. Existing environment
2. Predicted effects
3. Mitigation measures

The EIS also endeavours to comply with the 2002 EPA Guidelines: Section 1.8: "*Size - It is in the interest of all parties that EISs are kept as concise as possible.*" Section 2.4.6: "*Wherever possible practitioners should aim to keep the length of the main volume of the EIS to less than 100 pages.*"... "*Comprehension can be influenced by language, editing and presentation.*"

Difficulties encountered

No difficulties were encountered during the compilation and production of this document.

Policy Context

International

In January 2007, members of the Intergovernmental Panel on Climate Change (IPCC) published a report entitled "*IPCC WGI Fourth Assessment Report – Summary for Policymakers*". Significantly, in 2001, the IPCC said that it was "*likely*" that human activities lay behind the climate trends observed at various parts of the planet; "*likely*" in IPCC terminology means between 66% and 90% probability. In the 2007 report, the panel concluded that it very likely, or at least 90% certain, that human emissions of greenhouse gases (GHG) rather than natural variations are warming the planet's surface.

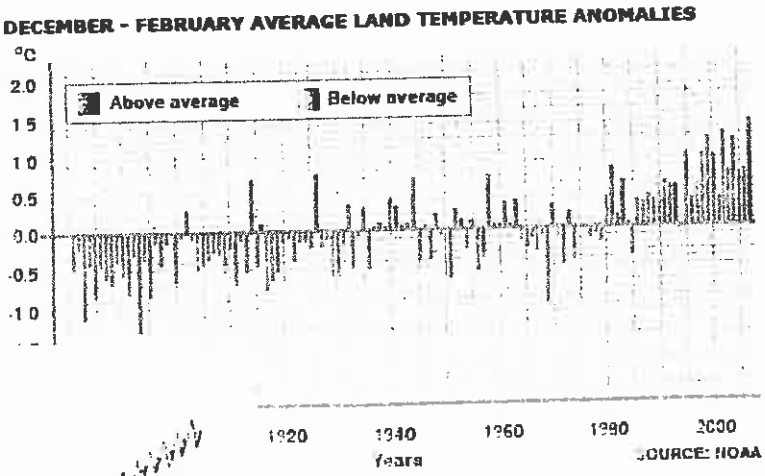
In April 2008, Dr James Hansen, director of the NASA Goddard Institute with eight other authors published a paper entitled "*Target atmospheric CO_2: Where should humanity aim?*". In the paper, the scientists examined direct physical historical evidence from ocean floor core samples. They found that 35 million years ago there was 450ppm of CO_2 in the atmosphere, which caused the mass melting of ice with sea levels 75m higher than today. The authors state:

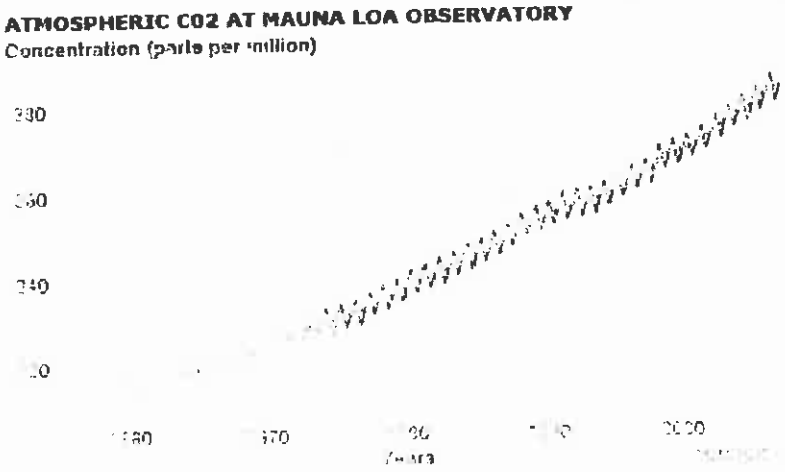
> *"If humanity wishes to preserve a planet similar to that on which civilization developed and to which life on Earth is adapted, paleoclimate evidence and ongoing climate change suggest that CO_2 will need to be reduced from its current 385ppm to at most 350ppm."*

Two years ago, Dr. Hansen warned that anything beyond 450ppm would tip us into an irreversible climatic collapse, a level that is predicted to be attained in less than 20 years at current fossil fuel consumption. The European Union's stated aim is to prevent CO_2 levels exceeding 550ppm. (Source: http://arxiv.org/abs/0804.1126)

Figure 4
IPCC 2007 REPORT - PROJECTIONS

- Probable temperature rise between 1.8°C and 4°C
- Possible temperature rise between 1.1°C and 6.4°C
- Sea level most likely to rise by 28-43cm [approx. 1ft]
- Arctic summer sea ice disappears in second half of century
- Very likely increase in heat waves
- Likely increase in tropical storm intensity





Kyoto Protocol

The 1997 Kyoto Protocol is an international agreement to limit human-induced GHG emissions. Ireland is a signatory to this agreement and is legally bound under the terms of the agreement to limit its increase in emissions of these gases to 13% over 1990 levels by 2010. Referring to the challenge, Sustainable Energy Ireland has highlighted the fact that *"under a 'business as usual' scenario, Ireland's greenhouse gas emissions would be ~40% CO_2 above its limitation target for 2010"*. As of February 2007, Ireland is 34% CO_2 above its limitation target for 2010.

EU Energy Policy

The EU currently meets 6.5% of its energy needs from renewable sources with 80% of its energy generated from fossil fuels – coal 30%, oil 30% and natural gas 20%, with increasing dependence on imported oil and gas, which could rise to more than 80% by 2030. EU Commission's Strategic Energy Review and supporting Action Plan was published in January 2007 and is a comprehensive set of proposals on the future shape of "Energy Policy for Europe" which the European Council has endorsed.

RES-E Directive: 2001/77/EC Directive on Electricity Production from Renewable Energy Sources: entered into force in October 2001 and promotes the use of renewable energy sources in EU electricity production. It sets voluntary targets for renewable energy production from member states - Ireland has a target of 13.2% or 1450MW by 2010 (voluntarily increased to 15% by the government).

In 2004, the European Parliament adopted a EUFORES (European Forum for Renewable Energy Sources) resolution 2004/2153, calling for a mandatory 20% target of renewable energy by 2020. On 9th March 2007, the EU Heads of State adopted a binding 20% target for renewables by 2020 as part of a developing EU Energy Policy for Europe.

Lisbon Agenda and Strategy: provides a framework in support of sustainable economic growth, better jobs, greater social cohesion and respect for the environment.

Irish energy market

The International Energy Agency estimates that, without policy change, global energy demand is projected to increase by over 50% between now and 2030 with fossil energy remaining the dominant source of energy.

Ireland relies on fossil fuel for over 90% of its total energy supply, which contributes 32% of Ireland's total CO_2 emissions with an annual demand growth of 5%. The current winter peak electrical demand was 4907MW reached in December 2007 with a maximum wind energy generation of 716MW generation during January 2008.

As of April 2008, 88 Irish wind farms are operational, generating a maximum export capacity of 866MW of wind energy, sufficient to power in excess of 570,000 homes. This usage represents 7% of electrical energy used in Ireland. Eirgrid Ltd., the state company which manages the national grid, has contracted a further 466MW to be operational by January 2010 and finalised the issue of binding connection offers for the supply of 1,321MW in December 2007. A further 4257MW are in the process of being considered for connection to the national grid pending network stability analyses and infrastructure investment by the network's regulators and operators.

Government Policy

The Electricity Regulation Act 1999

This Act enables effect to be given to Directive 96/92/EC, providing for the liberation of the electricity market to open competition.

Planning & Development (Strategic Infrastructure) Act 2006

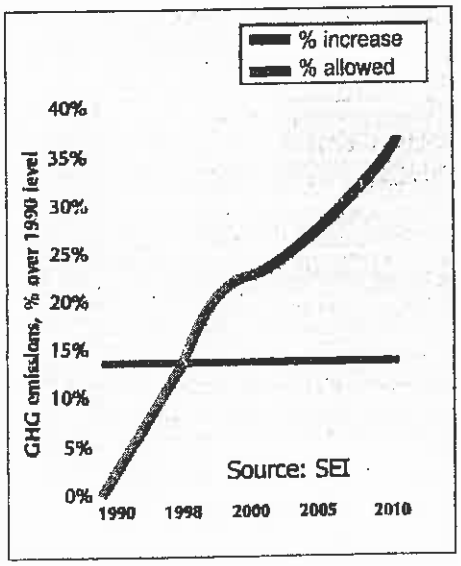
This act provides for the streamlining of the planning process for certain types of major energy, transport and environmental infrastructure of strategic importance. The new streamlined consent procedures apply to, among other things, wind farms.

National Development Plan 2007-2013

Investment Priorities and Framework: Environmental Sustainability: In line with the Lisbon Strategy, the promotion of environmental sustainability is a key objective of the investment strategy and will be underpinned by the ongoing integration of environmental considerations into the planning and execution of capital projects. The Energy Programme will see some €8.5bn in investment in energy. The Sustainable Energy Sub-Programme will make available €276 million to fund the large-scale development of wind energy capacity. The Strategic Energy Infrastructure Programme will make available over €1.25 billion to be invested in key strategic energy infrastructure projects including, *inter alia*, new electricity interconnections.

White Paper: Delivering a Sustainable Energy Future for Ireland: The Energy Policy Framework 2007 – 2020

This White Paper sets out the Government's Energy Policy Framework 2007-2020 to deliver a sustainable energy future for Ireland. It includes a commitment to fuel diversity and delivering a 2020 target of 33% of electricity from renewable energy sources. Wind energy will provide the pivotal contribution to achieving this target. It also commits to the transformation of the generation portfolio between 2007-2013 through planned divestment of 20% of the existing ESB plant portfolio by 2010, matched by the support of independent operators to replace plant which will support and complement the growth in wind generation.



National Climate Change Strategy 2007-2012

The Government's National Climate Change Strategy 2007-2012 sets out a six year policy framework for achieving the necessary greenhouse gas reductions towards Ireland's compliance with the Kyoto Protocol (13% limitation target on 1990 emissions by the first commitment period 2008-2012). This will involve the reduction of 17.22 Mt Co_2 equivalent over the 2008-2012 period.

The Strategy also commits the State to generate 15% of its electricity from renewable sources by 2010 and 33% by 2020 while biomass is to contribute up to 30% of energy input at peat stations by 2015.

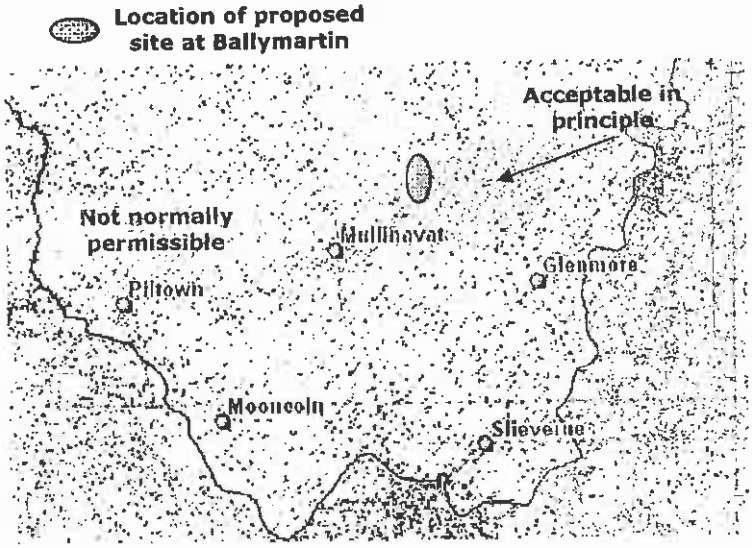
Wind Energy Development Guidelines 2006

The Department of Environment's Wind Energy Development Guidelines for Planning Authorities 2006 are designed to ensure consistency of approach to wind energy developments throughout the country and to provide clarity to prospective developers and local communities.

Kilkenny County Development Plan 2008-2014

- Chapter 8, Section 8.2.1 : The proposed wind farm site is not designated as a National Heritage Area (NHA), Special Area of Conservation (SAC) or Special Protection Area (SPA).
- The proposed wind farm site is located in the South Western Hills Landscape Character Area (Appendix E - Map13) within the Landscape Unit 'Upland Areas' (Principle Policy Area; Appendix E – Section 5).
- Chapter 9, Section 9.8.3.3 'Wind Energy'; Section 8 of Wind Energy Development Strategy 2007 : Allow development in all areas highlighted as being 'Acceptable in Principle'.
- Appendix D of the Kilkenny County Development Plan 2008-2012 defines designated Views to be preserved and protected and lists Areas of High Amenity. The Ballymartin North site does not fall within the viewshed or compromise any designated Views or Areas of High Amenity.

Extract from Kilkenny County Development Plan 2008-2014
Map15: Kilkenny Wind Energy Development Strategy Map



Public Surveys of Wind Energy

Wind energy projects are by their nature sites in exposed locations and are visible in the landscape. The public acceptability of the visibility of such projects is an issue of concern to planners and policy makers. Because of this, objective surveys have been commissioned in order to quantify such public attitudes and how such attitudes change with direct experience of wind turbines.

Sustainable Energy Ireland 2005

This report is Ireland's first independent study of the Irish public's attitude towards the development of renewable energy. The study found that:

- the overall attitude to wind farms is almost entirely positive. More than eight out of ten believe wind energy to be a very or fairly good thing.
- wind farms are seen in a positive light compared to other utility-type structures that could be built on the landscape.
- two-thirds of Irish adults are either very or fairly favourable to having a wind farm built in their locality, with little evidence of a 'Not In My Back Yard' effect.
- the public are not greatly concerned about the impact of medium-scale wind farms upon scenic beauty, irrespective of the type of landscape.
- there is a preference for smaller, clustered groups of turbines over larger scale installations. Preference for larger turbines (in smaller numbers) over smaller turbines (in larger numbers) is clear.
- those with direct experience of wind farms in their locality do not in general consider that they have had any adverse impact on the scenic beauty of the area, on wildlife in the area, or on tourism.
- those with direct experience of a wind farm in the locality are generally impressed with it as an additional feature in the landscape, adding interest and perhaps associating the locality with progressive, 'green' connotations.
- over 60% of those living in close proximity to existing wind farms would favour either an additional wind farm in the area or an extension to the existing one. Fewer than 20% state that they would be against a further wind farm development, but 7% express themselves as strongly opposed.
- over eight in ten are favourable to the construction of more wind farms in Ireland. It is particularly encouraging that those with experience of wind turbines are most favourable to their development and that wind farms are not solely seen as good in theory, but are also seen as beneficial when they are actually built.

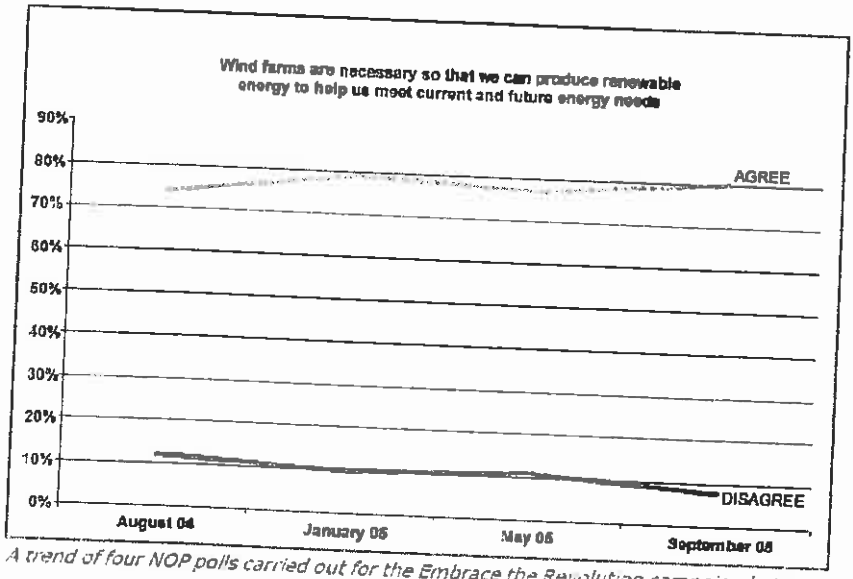
IWEA Public Attitude Survey 1999

1060 adults were surveyed. The highlights of the study were as follows:

- When asked to rank forms of energy in terms of their environmental friendliness, wind power attracted the highest score. From an optimum score of 8, wind energy scored 6.44. Most fossil fuels were in the 3 to 4 range, with coal lowest 1.9.
- Two-thirds (67%) felt that the Government should support the development of wind energy in Ireland, and 66% felt that Europe should support it. 80% support the development of electricity from environmentally friendly sources.
- 93% of those who are aware of wind energy support its development.
- Positive attitudes to wind energy centre around the following:
    - It is natural (83%)
    - It is clean (80%)
    - It is environmentally friendly (75%)
    - Concerns about wind energy centre around the following:
    - Dependability (23%)
    - Continuity of supply (19%)
    - Appearance (12%)
    - Sound (8%)
    - 13% saw no disadvantages

BWEA Public Attitude Survey 2005

- 80% agree that wind farms are necessary so that we can produce renewable energy to help us meet current and future energy needs – 8% disagree
- 62% agree wind farms are necessary to produce renewable energy – what they look like is unimportant



A trend of four NOP polls carried out for the Embrace the Revolution campaign between September 2004 and September 2005 © BWEA

Wind Farm Site Selection

Suitable Characteristics of the Ballymartin North Site

Wind energy material asset

Wind speeds at the Ballymartin North site are substantial with an annual mean value in excess of 7.75 metres per second. This is a significant material asset, sufficient for an economically viable wind energy generation project at current market.

Proximity of a suitable & available national grid connection

The electricity produced by a wind farm must be exported efficiently to the national grid. The connection point to the grid needs to be close to the proposed wind farm to minimise capital costs and resistive losses. The nearest grid connection point at the adjacent Ballymartin Wind Farm, has a suitable and available grid node (Kilkenny County Council Ref. P.07/2140).

County Development Plan 2008-2014 – Wind Energy Development Strategy 2007

Kilkenny County Council's County Development Plan 2008-2014 incorporates the 'Wind Energy Development Strategy 2007' which states in Section 8: *"it is Council Policy to allow development in all areas highlighted as 'Acceptable in Principle."* The proposed wind farm site at Ballymartin North is located in the north-west region of Co. Kilkenny within a region in which wind energy development is Acceptable in Principle. Also, Section 8 states *"all windfarm sites within this Strategy Area will be intensified in the future by a) taller turbines with larger swept areas, b) higher densities and c) more advanced technology with higher efficiencies of energy capture."* The proposed 3 turbine clustered development at Ballymartin North satisfies all the above strategy criteria.

No national heritage designation

The wind farm site is not designated as a National Heritage Area (NHA; Wildlife Amendment Act, 2000), a Special Protection Area (SPA; Directive 79/409/EEC) or a Special Area of Conservation (SAC; Directive 79/409/EEC). No known archaeological artefacts are present on the proposed site.

Land use

The site is currently grazed and farmed, which implies that:

- no rare ecological habitat will be disturbed during wind farm construction or operation
- no archaeological artefact will be disturbed during wind farm construction or operation
- no adverse effect on land usage: farming activity will be able to continue as normal

Site access

Good road access is essential in both the construction stage and during operation of a wind farm. The proposed site will be served by the regional primary road network and local minor roads while on-site access will utilise newly constructed site access tracks.

Proximity to neighbours

Wind turbines need to be sited away from habitation mainly due to the possibility of the turbines being audible at residences. The sound levels at near-by dwellings will not exceed national guidelines.

Alternative wind farm sites & designs

The proposed wind farm site at Ballymartin North was chosen for the reasons stated above. The landowner wish to fully and efficiently utilise the material energy asset on their landholding and maximise the positive planning classification with respect to the suitability of specific landscape in the county of Kilkenny for wind energy development. Therefore, no other potential wind energy location or site was considered by the applicant for the development of a wind energy project.

The utilisation of smaller-sized turbines (i.e. 50m-hub height or less) was initially considered but it was concluded that due to future technological developments, transport issues and energy production considerations that it was most beneficial to harness the wind energy on the proposed site using the most up-to-date industry standard turbines.

A three turbine layout was considered most appropriate in order to fully utilise the identified wind energy asset at Ballymartin North and to gain the maximum environmental and commercial benefit from any development planning decision.

Landscape & Visibility

The existing environment

The proposed site, with a topographic high of 212m, is located 5.1km northeast of Mullinavat village and 2.9km southwest of Brabstown crossroads. The hill has a very gentle rounded southern aspect with views to the west, south and south-east. Land cover on the Ballymartin North site is gently undulating improved grassland and hedgerows. The lands immediately northeast of the site have a topographic high of 230m. The low undulating hills surrounding the site to the northwest and southeast have extensive plantations of mature conifer monoculture.

A Wind Energy Development Strategy plan and a Landscape Character Assessment study have been incorporated into Kilkenny County Council's current Kilkenny County Development Plan 2008-2014. 'Wind Energy Development Strategy 2007' states in Section 8: : "*it is Council Policy to allow development in all areas highlighted as 'Acceptable in Principle'*." The proposed wind farm site at Ballymartin North is located in the central south-eastern region of Co. Kilkenny within a region in which wind energy development is Acceptable in Principle.

In the Landscape Character Assessment study, the proposed wind energy development site is located in the 'South Western Hills' Landscape Character Area (Map13) within the Landscape Unit 'Upland Areas' (Section 5). Indicative Landscape Policies, contained in Section 6 of the Landscape Character Assessment study, have been formulated for each landscape unit and are based on an appraisal of landscape sensitivity and robustness criteria (Section 5).

Appendix D of the Kilkenny County Development Plan 2008-2012 defines designated Views to be preserved and protected and lists Areas of High Amenity. The Ballymartin North site does not fall within the viewshed or compromise any designated Views or Areas of High Amenity.

Under PL.10.208178, An Bord Pleanála gave approval for three 60m hub-height wind turbines on an adjacent site immediately south of the proposed Ballymartin North site. Under current KCC Ref. P.07/2140, a hub-height increase of this PL.10.208178 project is being sought from Kilkenny County Council from the approved height of 60m to 79m.

The site at Ballymartin North is not freely accessible to the public, is in private ownership and does not possess unique landscape, national heritage or aesthetic values.

The predicted effects of the proposed project

A wind farm has both a horizontal and vertical theoretical visibility. With this in mind, Zone of Theoretical Visibility (ZTV) modelling based on 79m nacelle (hub) and 99m half-blade visibility was conducted and is graphically represented in Figures 5a and 5b respectively.

Regional topography is the sole factor taken into account in determining vertical visibility; hence areas not coloured in Figure 5a and Figure 5b will not have a view of the wind farm since high topography will screen the turbines from view from that particular viewpoint.

Also, it is important to note that the above modelling represents a worst-case theoretical scenario. In addition to topographic screening, the wind farm will not be visible due to ubiquitous local features such as trees, hedging, buildings etc. Also, local atmospheric conditions, such as hill mist, will obscure views of the turbine.

Theoretical landscape visibility based on nacelle & half-blade targets

Due to the undulating topography of the region around the wind farm site the visual effect caused by the development will vary from location to location. A ZTV map attempts to graphically portray this variability by categorising the number of turbines seen at a particular place and then colour coding the location. Thus, the technique essentially 'contours' the turbine's visibility to make it easier to interpret the information.

Again, please note that the following visibility analysis is based on the proposed three turbines at Ballymartin North (79m hub height, 82m rotor diameter) combined with the approved three turbines at Ballymartin (PL.10.208178) with a proposed hub-height increase of 19m to 79m (KCC Ref. P.07/2140). Therefore, the combined six turbines have the same turbine specifications in the following visibility model: 79m nacelle and 82m rotor diameter.

A 20km square ZTV model centred on the proposed wind turbine array resulted in a ZTV coverage area of 1604km^2. With no additional local screening effects, approximately 65% the surrounding landscape will have no view of the turbines' nacelle or half-blade targets.

Theoretical nacelle visibility summary

	Visibility	Area (km^2)	Percentage
Nacelle visibility	**1 nacelle visible**	32.08	2.00
79m	**2 nacelle visible**	31.92	1.99
	3 nacelle visible	36.48	2.27
	4 nacelle visible	29.94	1.87
	5 nacelle visible	37.40	2.33
	6 nacelle visible	394.38	24.59
	None	1041.81	64.95
Half-blade visibility	**1 half-blade visible**	30.51	1.90
99m	**2 half-blade visible**	29.77	1.86
	3 half-blade visible	32.72	2.04
	4 half-blade visible	28.35	1.77
	5 half-blade visible	35.66	2.22
	6 half-blade visible	472.27	29.44
	None	974.73	60.77
	Total	**1604.0**	**100.00**

When the data in the above table is assessed in conjunction with the 20km-square ZTV maps in Figure 5a and Figure 5b a general distinction can be recognised between approximately one quarter of the region which will have a theoretical full view of the turbines while the remaining 65% of the region will have no view of the turbines. This type and scale of regional visibility is positively described in the DoEHLG's Wind Energy Development Guidelines 2006: "6.3.1 Location: *...to achieve full turbine exposure from sensitive key viewpoints, as the perception of complete turbines is more aesthetically pleasing than stunted turbines."*

Theoretical visibility from regional population centres & specific locations

Brabstown crossroads, 2.9km northeast of the site, will have partial views of the turbines - refer to Fig.12 Viewpoint 7 photomontage.

The village of Mullinavat, 5km southwest of the site, will have no view of the proposed turbines - refer to Fig.9 Viewpoint 4 photomontage.

Hugginstown village, 11.5km to the northwest of the proposed site, will have full but distant views of the turbines.

Dunnamaggan village, 17.8km to the northwest of the proposed site, will have full but distant views of the turbines.

New Ross, Co. Wexford will have full views of the turbines on the eastern side of the town, in the vicinity of Portersland townland. The distance from this townland to the Ballymartin site is approximately 12km.

Kilmacow village, 10km to the southwest of the proposed site, will have full but distant views of the turbines' rotors.

Mooncoin village, 15km to the southwest of the proposed site, will have full but distant views of the turbines' rotors.

Waterford City, 14.5km due south of the proposed site, will have no views of the wind turbines.

Theoretical visibility from local minor roads

Three Friar's crossroads (R407) – Bishopstown – Knockbrack

There will full views of the proposed turbines from the Three Friar's crossroads on the R704, with the closest turbine at 477m - refer to Fig.14 Viewpoint 9 photomontage. At a fork junction 2.25km south a partial view of the turbines' rotors is available due to screening effect of mature coniferous forestry in the foreground - refer to Fig.6 Viewpoint 1 photomontage. Further south, at the next crossroads in the townland of Bishopstown, only partial view of the turbines' rotors is available again due to screening effect of mature coniferous forestry in the foreground - refer to Fig.7 Viewpoint 2 photomontage. Full views of the turbines' nacelles are available further south of this junction as far Knockbrack townland where the minor road drops in elevation to the south.

Ballynoony West crossroads (R704) – Mullennakill

The majority of this minor road will have no views of the proposed turbines due to the presence of mature coniferous forestry to the east which screens any view of the Ballymartin North site as viewed from the road. There will full views available at the northern end of the road in the townland of Mullennakill where the forestry ends - refer to Fig.11 Viewpoint 6 photomontage.

Theoretical visibility from regional national roads

N9 Waterford - Mullinavat – Thomastown

The majority of the N9 primary road from Waterford City to Thomastown will have no views of the wind turbines. Intervening high ground, distance to site and roadside hedging reduces any theoretical visibility to low levels. High ground in the vicinity of Tory Hill (292m) will screen the site from view from the N9 south of Mullinavat. The turbines will be partially visible east of Castlegannon townland at a distance of 6.9km - refer to Fig.10 Viewpoint 5 photomontage. The landscape north of Thomastown in the vicinity of Farne will have full but distant views of the turbines, 18km to the south.

N10 Knocktopher – Stoneyford

No section of the N10 will have a view of the proposed turbines.

N24 Waterford – Mooncoin - Piltown

Full views of the proposed turbines' rotors are available along the section of the N24 primary road between the townlands of Ballygriffin and Mooncoin. All other sections of the road will have no views of the turbines.

N25 Waterford – Glenmore - New Ross - Ballynabola

Users of the N25 between Waterford City and New Ross will have no views of the turbines along the majority of the route. At Ballynamona, south of Glenmore, the turbines' rotors may be visible 6.7km to the northwest. East of New Ross, in the vicinity of the N30 junction in the townland of Portersland, full views of the turbines' rotors may be available at a distance of 12.4km to the west.

N25 Waterford – Kilmeadan – Newtown
Users of the N25 between Waterford City and Newtown will have no views of the turbines along the majority of the route. At Ballyduff East near Kilmeadan, the turbines' rotors may be visible 20km to the northeast.

N30 New Ross – Ballintober
Users of the N30 east of New Ross will have no views of the turbines along the majority of the route, except at Ballintober, where the turbines' rotors may be visible 16km to the southwest.

R704 Mullinavat – Brabstown – New Ross
Full views of the proposed turbines are available along this regional road between the townlands of Simonsland and Clomantagh - refer to Fig.12, Fig.13 and Fig.14 viewpoint photomontages. All other sections of the road will intermittent partial or no view of the turbines.

R700 New Ross – Inistioge - Thomastown
Two sections of this regional route will have full views of the wind turbines' rotors at varying distances: between the townlands of Ballycommon and Oldcourt townland and in the townland of Dysart. No views are available from the remaining sections of this route.

R703 Thomastown – Graiguenamanagh - Coolnamara
No section of the R703 will have a view of the proposed turbines.

R729 New Ross – Glynn – Coolnamara
Most of this regional route will have no views of the wind turbines. In the townlands of Dranagh (east of Saint Mullin's) and Ballynabanoge distant views of the turbines' rotors may be available.

R731 Ballynabanoge – Ballywilliam
Most of this regional route will have no views of the wind turbines. In the townlands of Ballynabanoge and Ballywilliam distant views of the turbines' rotors may be available.

R733 New Ross – Ballinteskin – Dunbrody – Arthurstown - Curraghmore
Most of this regional route will have intermittent views of the wind turbines' rotors with varying visibility depending on distance to the Ballymartin site, intervening landscape features and local roadside screening.

R734 Ballinteskin – Balliniry
Most of this regional route from Ballinteskin to the townland of Dunmain will have no views of the wind turbines. South of Dunmain the landscape rises and distant views of the turbines' rotors may be available to the northwest.

R698 Fiddown – Coolaghflags - Callan
Most of this regional route from Ballinteskin to the townland of Dunmain will have no views of the wind turbines. At the townland of Coolaghflags the landscape rises and distant views of the turbines' rotors may be available, 22km to the southeast. The immediate region in the vicinity of Callan may have full but very distant views of the turbines, 26km to the southeast.

Theoretical cumulative visibility

Under PL.10.208178, An Bord Pleanála gave approval for three 60m hub-height wind turbines on an adjacent site immediately south of the proposed Ballymartin North site. Under KCC Ref. P.07/2140, a hub-height increase of this PL.10.208178 project is being sought from Kilkenny County Council to 79m. These three approved turbines were included in the cumulative visibility model at the proposed 79m height (P.07/2140).

Visibility	Area (km^2)	Percentage
Ballymartin North 3T 79m hub only	29.39	1.83
Ballymartin 3T 79m hub (P.07/2140) only	5.70	0.36
Guilkagh 5T 60m hub only	168.69	10.52
All (at least 1 turbine from each wind farm)	314.90	19.63
None	1041.81	64.95

A five turbine wind farm at Guilkagh More, 4km to the northeast of the Ballymartin North site, has full planning permission. To date, no site development exists.

The theoretical cumulative visibility of these wind farms is graphically portrayed in Figure 5c based on nacelle visibility: 79m for Ballymartin and Ballymartin North and 60m for Guilkagh.

Other considerations

In addition to the turbines, other elements of the project, such as access tracks, may be visible. These elements are of small scale when compared to both the site and the turbine array and will therefore have minimal additional visibility.

Measures to lessen adverse effects

Commercial and design constraints means that it is not possible to substantially reduce the scale of modern wind turbines. The fact that wind speeds significantly increase with elevation and that a doubling of wind speed would result in an eight-fold increase in electrical output means that any reduction in elevation or scale is not a commercially viable design option. Furthermore, economies of scale operate in the financing of wind energy projects and in a competitive open-market environment only turbines that maximise the harnessing of the wind energy resource of a site will secure supply contracts. In addition to the above issues of scale, the movement of the blades is an inherent part of wind turbine operation and is not an element which can be modified.

The above characteristics mean that the visibility of wind energy projects cannot be modified substantially. Stanton (1996) points out that: "*This characteristic exposure, in addition to the height of wind turbines, results in wind farms being highly visible, although this also relates to a number of other variable landscape characteristics, for example weather conditions, the mode and speed of viewing and the nature of the surrounding landscape*". Therefore, wind farms will generally be visible in the landscape and few mitigating factors are possible. Nevertheless, a wind farm should appear neat and ordered on the landscape. Stanton (1996) again states: "*A wind farm possesses visual relationships between each turbine, in addition to the landscape as a collective group. This relationship must appear clear and simple in order for a development to seem rational*".

Tapering, tubular steel towers and a matte white colour scheme are now industry standard. Tapering tubular towers appear simple and sculptural on the landscape in contrast to older lattice tower constructions, while the industry consensus is that white is the colour option with the most neutral effect and is a colour associated with purity and cleanliness, in keeping with the public's general attitude to renewable energy.

Ballymartin North is a quiet location with few or no human noise-generating activities. Similarly, the surrounding areas within one kilometre can be classified as "quiet rural".

There are two types of sound emissions associated with the operation of wind turbines:

1. the sound made by the aerodynamic rotation of the rotor blades. However, the wind in your ears, in the trees and around buildings causes similar sound and this substantially masks the aerodynamic sound from turbine rotors. For this reason, at more than two or three hundred metres away, this aerodynamic sound is indistinguishable by the human ear from other wind sounds. If the wind speed is below 4m/s, the turbines do not operate and are therefore completely silent.

2. the sound made by the normal operation of the turbine generator. In the past poorly designed turbine generators produced tonal sounds from the gearbox. In addition, impulse-type noises could be produced from unprofessionally maintained turbines. Modern, well maintained turbines do not suffer from this design flaw. A 1995 survey (Krohn 2000) on research and development engineering priorities of Danish turbine manufacturers showed that no manufacturer considered mechanical sound as a problem any longer since sound emissions had dropped to half their previous level.

An operating wind turbine produces a level of 'Sound Power'. When a certain sound power is measured it is known as a 'Sound Pressure Level' and has units of decibels (dB) - an increase of 10dB sounds roughly like a doubling of environmental loudness. The measurement of environmental sound are made in dB(A), in which the measured sound frequencies are weighted with the frequencies the human ear is more sensitive to weighted more than other frequencies. In the case of sound emissions from wind turbines A-weighting is used and this weighted sound pressure is expressed in units of dB(A).

noise level	audibility	whisper	speech	city traffic	rock concert
dB(A)	0	30	40-60	90	120

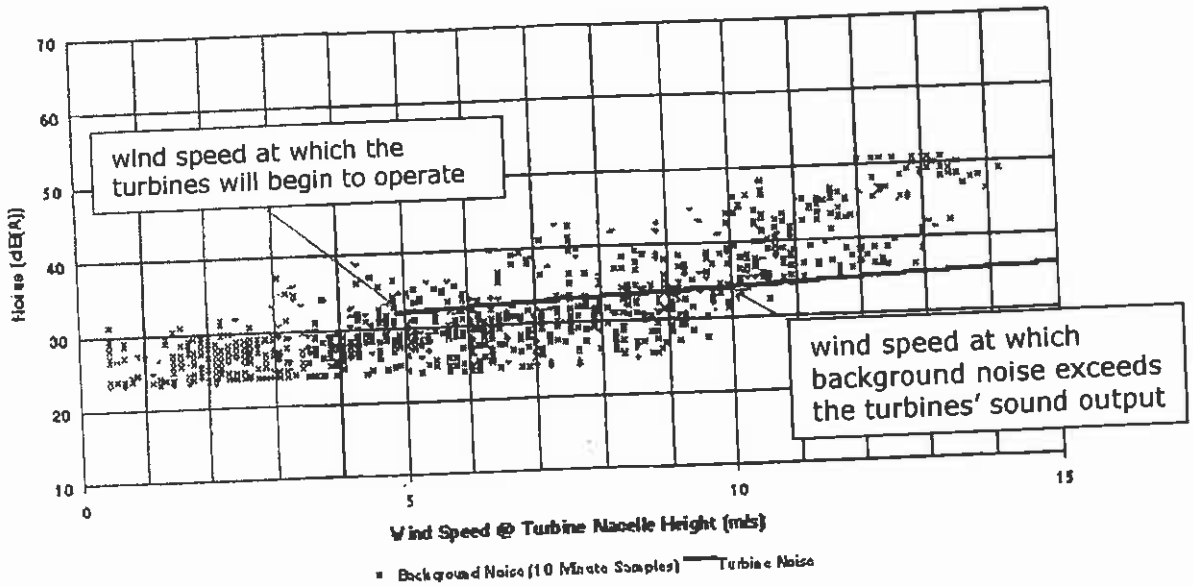
The sound pressure emitted from an operating turbine disperses in a spherical pattern around the turbine with the sound energy decreasing with the square of the distance from the source. The sound power level from a single wind turbine is usually between 90dB(A) and 110dB(A) (the sound power level at the hub height of the turbine at a wind speed of 10m/s with the wind speed measured at a reference height of 10m). This sound power level creates a sound pressure level of 50-60dB(A) at a distance of 40 metres from the turbine, the same level as conversational speech. At a house 500m away, the equivalent sound pressure level would be 25-35dB(A) when the wind is blowing from the turbine towards the house; when the wind is blowing in the opposite direction the sound pressure level would be 10dB(A) lower. When there are a number of sources, i.e. an array of wind turbines at one location, the sound emissions interfere with each other and their energy is added.

It is important to note that any sound emitted from wind turbines is significantly dampened as a result of a number of environmental variables including air density, trees and buildings. Sound pressure dispersion modelling does not include this considerable environmental effect as a model variable and so prediction results from any such modelling exercise [illegible] are erroneous.

Sound pressure level dispersion modelling

The effect of broadband sound emitted by the turbines on dwellings has been modelled using an Enercon E82 2.3MW turbine with 79m hub with a broadband power output of 103.4dB(A) for the three Ballymartin North turbines and using an approved (PL.10.208178) level of 101.5dB(A) for the three turbines on the adjacent property. The result of the model is mapped as the Sound Dispersion Map.

Background Noise and Turbine Noise vs. Wind Speed



This contour map shows that at an annual mean site wind speed of 8m/s, no dwellings will be within the resultant 45dB(A) sound level, an appropriate level for a rural area with a background noise level above 30dB(A). Any sound output will be minimised by operating professionally maintained modern turbines.

The specific turbine model chosen after commercial tendering will have a comparable sound pressure rating as that modelled above and will be agreed with the Planning Authority prior to construction.

Measures to lessen adverse effects

The DoEHLG Wind Energy Development Guidelines 2006 state:

"5.6 Noise limits
...a lower fixed limit of 45 dB(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.

However, in very quiet areas, the use of a margin of 5dB(A) above background noise at nearby noise sensitive properties is not necessary to offer a reasonable degree of protection and may unduly restrict wind energy developments which should be recognised as having wider national and global benefits. Instead, in low noise environments where background noise is less than 30dB(A), it is recommended that the daytime level of the LA90, 10min of the wind energy development noise be limited to an absolute level within the range of 35-40dB(A).

Separate noise limits should apply for day-time and for night-time. During the night the protection of external amenity becomes less important and the emphasis should be on

preventing sleep disturbance. A fixed limit of 43dB(A) will protect sleep inside properties during the night.

In general, noise is unlikely to be a significant problem where the distance from the nearest turbine to any noise sensitive property is more than 500 metres."

By using proven, industry standard turbines tonal sounds will be eliminated. The developer undertakes to operate new turbines that have passed examination by international certification agencies such as Germanischer Lloyd and possess a Class 1 certification.

The developer further undertakes that any sound output will be minimised by the regular and professional maintenance of the turbines.

Telecommunications

Existing environment

At the moment the quality of telecommunication signals is likely to be very good in the general area of the Ballymartin North.

Predicted effects of the proposed project

It is possible that the motion of the blades could interfere with TV signals in the area of the wind farm. This occurs either through the direct obstruction of the signal or by the reflection or scattering of the signal either upstream or downstream. These processes can affect the signal at any stage of its transfer from source to customer. However, the degradation of a signal between relay stations (rebroadcast link) is more serious than effects on end stage signals to customers as any problems will affect all customers downstream. The further towards the source the problem is the more customers will be affected.

However, local scattering effects cannot be ruled out. These can cause secondary signals to arrive at the customer's antenna in addition to the main broadcast and ghosting of the image can occur. This effect is also caused by many other natural and man-made features that cause signal reflection but those caused by wind farms may be intermittent due to blade rotation. Such issues are generally associated with metal or carbon fibre blades and not to the same extent with blades made from the modern fibreglass composite blades.

Mobile phone communication: The developers contacted all relevant mobile phone companies regarding the proposed project and all confirmed that no intereference issues will arise from the operation of any of the proposed turbines at Ballymartin. The relevant correspondance is included in the appendices.

Measures to lessen adverse effects

The developer will use fibreglass composite blades in this project in order to minimise the minor potential of signal interference.

RTÉ protocol between a wind farm developer and RTÉ Networks Ltd.

Interference with RTÉ installations (transmitter stations, transposers etc.)

Where RTÉ detects interference with the reception of a Receive and\or transmission signal at a transposer site, RTÉ will investigate the cause of the interference and will report in writing to the Developer if it determines that the interference is attributable in whole or in part to the wind farm development.

A copy of the protocol document is included in the appendices for reference.

Other Effects on Humans

Site transport access

The anticipated effects of the proposed wind farm at Ballymartin North on the regional and local transport routes can be divided into the construction phase and the operational phase.

The construction phase will involve the transportation of equipment and materials for approximately three to four months. This traffic will include the movement of approximately 40 oversize loads including a 500 tonne crane, 150 tonne crane, articulated loads with turbine components as well as normal sized traffic movements of heavy equipment such as excavators and trucks.

Turbine components will access the site using articulated vehicles by the following route:

- ⇒ A) N25: Rosslare EuroPort – New Ross – Waterford City
- ⇒ B) N9: Mullinavat
- ⇒ C) R704: Three Friar's crossroads
- ⇒ D) Site entrance off local minor road south of C)

In engineering terms, all access routes and bridges must be able to withstand the passage of loads up to an axle load of 12 tonnes and an overall weight of 120 tonnes. The transport route has been surveyed and assessed and has been found to be adequate, requiring no necessary road or infrastructure improvements. Transport will be planned and managed by professional exceptional load transport managers.

Estimation of construction phase traffic:

Items	No. of loads	Notes
Plant equipment	1	Bulldozers, trucks, etc.
Concrete, steel etc.	175	$8m^3$ concrete capacity
Crane	2	500 and 150 tonne lifting strength
Tower foundation	3	1 foundation per load: 15 tonnes
Tower	12	4 section tower: 35, 48, 55, 61 tonnes
Nacelle	3	1 nacelle per load: 17 tonnes
Rotor hub	3	1 hub per load: 23.5 tonnes
Generator	3	1 generator per load: 54 tonnes
Rotor blades	12	1 blade per load: length 41m, 8 tonnes
Electrical equipment	10	Transformers, ducting, cabling etc.

Depending on specific ground conditions, the foundations for each turbine will require approximately $440m^3$ of HM-15 and HA-30 concrete in addition to approximately 41 tonnes of B500S reinforcing steel. Together with other material and components, the total number of delivery loads is projected to be 220 during the construction phase. This volume of delivery traffic will be spread over construction time and will average approximately four to five loads per working day. This traffic will peak during construction of foundations and delivery and erection of the turbine components and will be correspondingly less at other periods.

The operational phase will involve site traffic that will be limited to weekly or monthly passage of a light van with the possibility of a truck or crane making infrequent visits, perhaps less than once a year.

Shadow flicker

Shadow flicker is a visual phenomenon which may occur when the rotating blades of a wind turbine cast an intermittent shadowing over an nearby receptor such as an occupied house.

Shadow flicker is only possible if an exact combination of specific criteria occur simultaneously. The following explanatory formula demonstrates the combination of specific criteria that need to occur simultaneously for the effect to be theoretically experienced:

$$A_{RT} + C_0 + S_D + P + W + O = SF$$

where:

A_{RT} = angle from receptor to turbine: specific receptor must be 130 degrees either side of north relative to the turbine
C_0 = zero cloud or local fog => blue skies
S_D = direct sunlight, i.e. no local screening obstruction e.g. hedging, trees, buildings etc.
P = <700m proximity to specific receptor
W = the direction of the prevailing wind is southwest for approx. 70% of the time; therefore windows facing perpendicularly to this direction will not be affected
O = observer
SF = shadow flicker effect experienced by an observer

The DoEHLG's Wind Energy Development Guidelines 2006 state:

"It is recommended that shadow flicker at neighbouring offices and dwellings within 500m should not exceed 30 hours per year or 30 minutes per day. At distances greater than 10 rotor diameters from a turbine, the potential for shadow flicker is very low."

Shadow flicker modelling using WindFarm 4.1 software indicates a *theoretical* worst-case occurance of shadow flicker at 3 dwellings with 700m of the proposed Ballymartin North turbines – see accompanying summary table and house location map. The model indicates that the level of shadow flicker at H2 and H3, 510m and 576m respectively from turbine T2, will exceed the guidelines *for dwellings within 500m of any turbine*. H2 is occupied by the landowner of the proposed development.

Shadow Flicker Model – summary table

House	Easting	Northing	Days per year	Max hours per day	Theoretical total hours	Likely total hours
H1	260587	125893	0	0	0	0
H2	261425	126893	153	0.69	84	25.20
H3	261523	127047	94	0.58	40.1	12.03
H4	261575	127224	40	0.52	16.2	4.86
H5	261851	127264	0	0	0	0
H6	262050	127620	0	0	0	0
H7	262105	127712	0	0	0	0
H8	262180	128063	0	0	0	0
H9	262185	128135	0	0	0	0
H10	262230	128155	0	0	0	0
H11	261445	127996	0	0	0	0
H12	261251	128150	0	0	0	0
H13	261084	128105	0	0	0	0
H14	260918	128036	0	0	0	0

In practice, shadow flicker effects will occur for considerably less time than the theoretical worst-case predictions. Recent research data from Armagh Observatory indicate that the number of blue skies days in Ireland has fallen dramatically by as much as 80% in the last 120 years. On average, Ireland now enjoys 9 blue sky days a year; in the 1910's this figure was 41 days per year.

In addition, information provided by the climate section of Met Éireann indicates that direct sunshine typically occurs for approximately 30% of daylight hours and at other times, the wind turbines are unlikely to cast shadows sufficiently pronounced to cause shadow flicker effects to occur. Furthermore, at times when the wind turbine rotors are not oriented directly perpendicular with respect to the receptor, the effect would not occur or the duration would be reduced due to the elliptical shape of the shadow cast. Furthermore, the houses highlighted in the above model as being theoretical vulnerable to shadow flicker are surrounded by mature trees which will screen any chance of the effect impacting on the occupants.

Therefore, the duration of any theoretical shadow flicker effects can been calculated for both worst-case and likely conditions, with the likely condition to be 30% of the worst-case scenario.

In conclusion, taking into consideration the presence of three vulnerable dwelling within 700m of the proposed turbines, the limited daily time window, the presence of vegetation screening around the vulnerable dwellings and the very low probability of the combination of all the specific criteria occurring simultaneously, it is reasonable to conclude that the potential for a tangible shadow flicker impact at Ballymartin is negligible.

Electromagnetic fields

The turbine and other electrical apparatus associated with a wind farm would create electromagnetic fields when operating but these would be minor when compared to the fields generated by the very high voltage transmission lines which operate at 400,000 volts (400kV). There is no evidence that electromagnetic fields of the strength generated by wind farms (110kV or lower) are injurious to human health. In addition, the electrical works associated with this project would be located well away from habitation.

Hazard from blade disintegration

The developers intend to use a well-proven three-bladed turbine model with Class 1 certification (e.g. Germanischer Lloyd). In addition, these turbines will be built with the potential for unusually high wind speeds at Ballymartin North in mind (up to 70 metres per second). During such conditions (experienced less than once every 100 years on average) it would be extremely hazardous to be anywhere out of doors and visitors would not be present on site. Nevertheless, Class 1 wind turbines are designed to survive such winds.

Flashing

Glossy turbine blades, rotating in strong sunlight may cause a distracting effect where sunlight is reflected from the blades in a rhythmic way. The effect is largely eliminated by the use of matte blade coatings and the developer undertakes to do this.

Counter rotation

The apparent rotation of one or more sets of turbine blades in a direction opposite to that of the others in a wind farm can be visually disturbing. This effect occurs mainly in wind farms where the turbines are widely distributed and where locally different wind directions may cause an apparent counter rotation when viewed from certain restricted angles. The clustering of the turbines at Ballymartin North makes this effect unlikely to occur.

Decommissioning of the wind farm

The developer undertakes to reinstate the site to its original condition (as far as this is possible) should the wind farm be unsuccessful for any reason. However, long-term supply contracts combined with the reliability of the wind resource and the inherent commercial value of the installation make this a very unlikely and speculative scenario. Experience in other parts of Europe has shown that the scrap value, even of obsolete turbines, more than covers the cost of their removal.

Effects on Ecological Condition & Functioning

Nature Conservation & Legislation
The Wildlife Act (1976) provides the main legal protection for flora and fauna in Ireland. This Act protects mainly against inappropriate activities that may have a negative impact on species (e.g. hunting, collecting, direct interference with species). The Wildlife (Amendment) Act 2000 provides a legal framework for the designation and protection of Natural Heritage Areas (NHA).

Two European Directives, the Birds Directive (74/409/EEC) and the Habitats Directive (92/43/EEC) are given effect in Irish law through the "Conservation of Wild Birds Regulations" (SI 291 of 1985) and the "Natural Habitats Regulations" (SI 94 of 1997), respectively. The Birds Directive aims to maintain vulnerable bird species, listed in Annex I of the Directive, at a favourable conservation status by designating internationally important bird sites as "Special Protection Areas" (SPA). In general terms, this refers to sites which hold at least 1% of a species biogeographic population, or over 20,000 waterfowl. Where the distribution of a species is dispersed, non-gregarious or not related to discrete sites, wider countryside measures are required. The Habitats Directive aims to protect and conserve natural habitats of international importance in the E.U. through the designation of "Special Areas of Conservation" (SAC).

Introduction

Report Structure
This report examines aspects of flora and fauna in separate sections under three headings: existing condition, potential impact and mitigation measures. In each section the existing status and condition is detailed, the nature and scale of any potential impacts from the construction and operation of the proposed wind farm is explored and appropriate mitigation measures that may be required to minimise and rehabilitate any potential impacts are proposed.

Sources
The information contained in this report has been sourced from:

1. an ecological field assessment of the proposed site carried out on 8th November, 2007. The survey used the standard Phase I Habitat Survey (JNCC 2005) using the habitat types of Fossitt (2000).
2. personal contact with National Parks and Wildlife Service (NPWS) regional conservation staff: Mr. Jimi Conroy, NPWS, 2 Patrick St., Kilkenny City.
3. up-to-date international literature, specifically in relation to impacts of wind farms on flora and fauna.

Flora & Habitats

Existing Status & Condition

The proposed windfarm site is primarily improved agricultural grassland (code GA1 – Fossitt, 2000). There are also earthen banks where hedgerow exists. The terrain is relatively flat to slightly undulating.

The improved grassland comprises Rye-grasses (*Lolium* spp.) in association with White Clover (*Trifolium repens*). Other grasses present include Bent (*Festuca* spp.), Crested Dog's-tail (*Cynosurus cristatus*) and Yorkshire Fog (*Holcus lanatus*). Frequently occurring 'agricultural' herbs include Creeping Buttercup (*Ranunculus repens*), Thistle (*Cirsium vulgare, C. arvense*), Dock (*Rumex* spp.), Chickweed (*Stellaris media*), Daisy (*Bellis perennis*) and Ribwort Plantain (*Plantago lanceolota*).

The earthen banks of the field boundaries are mostly vegetated with Bramble (*Rubus fruticosus*) with scattered Hawthorn (*Crataegus monogyna*) and Common Gorse (*Ulex europaeus*). There are a number of mature Silver Fir adjacent to the site

The area overall is not species-diverse, nor is there mature hedgerow present.

Potential Impact : Flora

Road construction and turbine installation will destroy the flora, where located and have an impact in the direct vicinity of these works. The area affected will represent approximately 1-2% of the total immediate landholding.

The construction phase will have the most direct negative impact on floral species. However, most of the site is grassland and is of little botanical interest. Destruction of some grassland and heath habitats will have little long-term ecological significance. Increased drainage resulting from construction works (e.g. access tracks) will have little impact on the habitats present, as there is little wetland habitats present. Because the land is mostly not very soft, heavy machinery traversing the area would do little long-term damage the vegetation.

Construction of turbine bases consists essentially of excavating a hole of approximately 15x15m down to bedrock and constructing the turbine base within this. The base is made of steel-reinforced concrete with or without a fill of hardcore beneath to raise the level of the base sufficiently. The process does not result in long-term drainage of the surrounding land.

The disposal of rock spoil from turbine excavation by dumping on adjoining vegetation would result in destruction of the underlying vegetation. The dumping of large amounts of soil for periods of months would have a similar effect.

Excavation and construction of the proposed windfarm could result in additional silt entering watercourses on site. This could cause excessive siltation of watercourses downstream. However, on this site, although a tributary of the Blackwater River is 0.5 km from the west of the site and the Arrigle River is 0.5 km to the east of the site, there are no outflowing streams \ drainage watercourses running from the site.

Mitigation Measures : Flora

The area of habitat lost due to the construction of the windfarm and associated infrastructure is relatively small (1-2% of immediate landholding). Some habitat destruction does occur due to construction of turbines and associated infrastructure. On a longer term and over a larger area, the access tracks and associated drainage ditches can cause some deterioration of the habitats present. However, the grassland and other habitats present are not of critical ecological significance. Construction work could result in excessive siltation of drains / watercourses on site.

1. Where possible, roadways will utilise existing tracks or previously disturbed ground.
2. Roads and heavy machinery will avoid areas of wetter ground.
3. The small amount of rock spoil from turbine excavations will be consumed in road making. The soil excavated from sites of turbine foundations will be stored temporarily on site, to be removed later.
4. Where excavation or construction works occur within 20 m of watercourses, steps will be taken to ensure excessive silt does not enter such watercourse. If necessary, silt traps will be installed during the excavation / construction phase and left in place until the surrounding vegetation stabilises.

Fauna

Existing Status & Condition

Avifauna

Hen Harrier (*Circus cyaneus*) nest c. 2.5 km north of the site in the Glenpipe area. However, there are no Hen Harrier nesting on site. Peregrine Falcon (*Falco peregrinus*) nest on the River Barrow, some 10 km from the proposed windfarm site, while Barn Own (*Tyto alba*) and Long-eared Owl (*Asio otus*) are quite possibly present in the locality. Osprey (*Pandion haliaetus*) have been recorded on the River Nore. (J.Conroy, pers. comm., 2003).

Kestrel (*Falco tinnunculus*), along with Sparrowhawk (*Accipiter nisus*), could utilise the area for hunting. Bird species which may frequent the site could include Snipe (*Gallinago gallinago*), Raven (*Corvus corax*), Woodcock (*Scopopax rusticola*) and Pheasant (*Phasianus colchicus*). Small birds such as Meadow Pipit (*Anthus pratensis*), Skylark (*Alauda arvensis*) and Stonechat (*Saxicola torquata*) may also occur.

In Ireland, Hen Harrier nest predominantly in second rotation coniferous plantations, pre-thicket plantation of less than 10 years and heather moorland. They favour upland areas (200 - 400 m) where there is a mosaic of semi-natural vegetation and, in particular, heath, bog and hill farmland. Most birds vacate breeding sites and move to lowland areas in winter. Hen Harrier were widely distributed in Ireland in previous centuries. By the 1950s, numbers had declined dramatically. However, with an increase in coniferous afforestation, there has been some recent recovery in their numbers. Now, there is a healthy population at 102 - 129 breeding pairs, limited by the carrying capacity of the breeding range (Irish Birds, 2002).

Peregrine Falcon is widespread and relatively common in Ireland, with c. 500 breeding pairs (Cabot, 1995). Long-eared Owl is seldom seen, spending the day roosting close to the trunk of a tree, only emerging at night to feed. They are more frequent in the east than the west with about 2,300 pairs, mostly in coniferous woodland (Cabot, 1995). Barn Owl are thinly scattered (600 - 900 pairs), generally south of a line from Galway to Dundalk and mostly in the east of the country (Cabot, 1995). Osprey is a migrant, leaving its nesting grounds in August or September for winter quarters in tropical and southern Africa.

Kestrel and Raven are relatively common in mountain, moor and farmland habitats, while Sparrowhawk is our commonest bird of prey. Meadow Pipit, Skylark, Stonechat, Snipe and to a lesser degree Woodcock and Pheasant are common on fields, wetlands and bogs.

Hen Harrier and Peregrine Falcon are listed for protection under Annex I of the EU Birds Directive.

Please refer to a Hen Harrier activity report by Cork Ecology Ltd. undertaken during April and May 2008, included in the appendices.

Mammal fauna
The mammal fauna present could include Fox (*Vulpes vulpes*), Mountain Hare (*Lepus timidus hibernicus*) and Irish Stoat (*Mustela erminea hibernica*). Badger (*Meles meles*) may venture into the site. None of these species are uncommon in Ireland.

Potential Impact

Avifauna
General
Wind power may have impacts on wildlife, including habitat loss, disturbance and direct bird mortality. Habitat loss occurs as a result of direct loss of physical features used by a species in the life cycle or as a result of disturbance from human presence and the noise of the turbines themselves during construction, operation and maintenance of the wind farm. Bird mortality can result from collision with the turbines, their support towers and any power lines related to the wind farm. These impacts can be minimised by sensitive siting and design, and in many situations wind turbines will have minimal effects on biodiversity (RSPB, 1996).

Deaths of raptors at wind farms in California and south-west Spain have occurred through collision with turbines, transmission lines and electrocution. In Holland, it was found that small songbirds and Black-headed Gulls were more susceptible to collisions than other birds, these being particularly vulnerable at dusk and at night. However, from limited work carried out in Wales, the scale of birds strike there does not appear to be of serious concern. Unless wind farms are sited on bird migration routes or in areas of high bird concentration, bird strike has not been found to be a major problem. Relevant British cases include:

- A study at Ovenden Moor Wind Farm in the Pennines found Golden Plover nesting within 30m of a turbine (Keighley, 1993; Percival, 1998)
- A study at Bryn Tytli showed no significant adverse effects on upland breeding bird communities (Philips, 1994). Peregrine falcon were subsequently found to be nesting within 250m of one turbine (Lloyd, 1996).
- Dulas Engineering Ltd (1995), in the wind farm impact study for the Cemmaes Wind Farm in Wales showed similar results.
- A study at Carno, a large hilltop wind farm of 56 turbines in Wales, also showed no adverse effects on birds using the site (Williams and Young, 1997).
- Hawker (1997) found that the turbines at an upland Scottish site had no effects on birds using the site.

Also, limited evidence form the UK suggests that many breeding birds are unaffected by operational wind farms, becoming habituated to the noise and movements of turbines (RSPB, 1996). In general, sound emitted from modern turbines is not considered a major disturbance factor to fauna. The RSPB (1996) recommends not siting wind farms in certain locations, including SACs, near high concentrations of migrant feeding or roosting birds or near known migration routes or regular flights paths, particularly of waterfowl.

Mike Madder (1997), states that the impact of a wind farm will very much depend on how close the turbines are to nesting sites. Also, a loss of habitat may result because the birds may avoid the wind farm location. Some types of turbine structures can facilitate the predation of small birds' nests by Ravens and crows, by supplying perching vantage sites (Carruthers, 1997). Also, birds perching on the turbines can suffer mortality by collision with the windmills.

Hen Harrier

- Bird strike

Hen Harriers fly to a small area in which it spends the day hunting and resting. In hunting, Hen Harriers quarter the area very slowly within a few feet of the ground. On such occasions, they would certainly avoid the windmills (King, 1994). In April and early May spectacular displays are performed. These range from wide circles, rising so high as at times to be lost from sight, to the wild undulating displays which have been described as "sky dancing". These displays serve both to attract a mate and to advertise occupancy of a territory (Picozzi). The soaring displays of the Hen Harrier normally take place high above its proposed breeding site, which would be within coniferous forestry (King, 1994). However, they can take place up to a kilometre from the nest site (Madder, 1997). There is also a risk of bird strike with the newly flying fledglings. For their first 2-3 weeks out of the nest, their flight is unsure and they would be prone to collision (Madder, 1997). There are no records of Hen Harrier in the vicinity of the proposed wind farm at Ballymartin North. Past records for Hen Harrier at Croaghan are c.10km distant from the proposed site. Therefore, even with this site being re-occupied in the future, the potential for bird strike is very low.

- Habitat loss

The RSPB (1996) has voiced concerns over siting wind farms within enclaves of open hill within large forest blocks. This may impact on species like Hen Harrier which require large open spaces to hunt in. Obviously, some potential hunting habitat loss will result where the wind farm is sited. However, taking account of low flying hunting technique of the harrier, it could still hunt in the vicinity of the turbines. If the raptor abandons the wind farm site, hunting areas can be 4 km or more from the roost and as small as 250 ha (Picozzi). Therefore, unless tracts of adjacent open spaces are lost, the Hen Harrier can easily utilise suitable territory nearby. In any case, Hen Harrier do not currently occur within the locality.

- Disturbance

From late March, the harriers move to their nesting grounds on the moors. Eggs are laid in large open nests on the ground from the end of April at one to three day intervals. (Picozzi). This is when disturbance from the wind farm construction could be most critical. When in place, the harriers will most likely become accustomed to the turbines. The major impact of human disturbance would be in the vicinity of the nests. Hen Harriers are known to aggressively attack intruders encroaching near a nest site (Watson, 1977). However, the nearest nesting site is c. 10 km distant and this has not been occupied for some time.

Please refer to a Hen Harrier activity report by Cork Ecology Ltd. undertaken during April and May 2008, included in the appendices.

Peregrine Falcon

- Bird strike

Adult Peregrine falcon have a fast, pigeon-like, dashing flight (Cabot, 1995). They capture their prey by plummeting downwards at speeds of up to 280km/hr, suddenly slowing its flight before striking upwards to sink its talons into the victim (Felix, 1986). However, being a very agile flyer, the strike-risk category would be low. Fledgling peregrine's flight is unsure which would make them somewhat prone to collision although this period is short making the risk of collision low.

- Habitat loss

Obviously, some potential hunting habitat loss will result where the wind farm is sited. However, the area covered by the wind farm is relatively small at 2% of overall landholding. Also, if the raptor abandons the wind farm site, it can easily hunt in suitable territory nearby. In any case, Peregrine falcon is quite adaptable in the type of territory it will utilise. This matter could become an issue if wind farms and coniferous forestry dominated the landscape, which is not the case, at present.

- Disturbance

Peregrine falcon nest in open country in rocky, wooded spots which command a wide view, as well as on coastal cliffs and sometimes on city towers (Felix, 1986). There are no suitable nesting sites in the direct vicinity of the proposed wind farm site. The nearest nesting pairs are over 10 km distant. Therefore, disturbance, even during the construction phase, will not be a factor.

Long-eared Owl and Barn Owl

- Bird strike

Owls are very low-level flyers and are, therefore, unlikely to collide with the windmills. They mostly hunt at night, but the owl's well developed night senses would minimise the likelihood of collision with the windmills.

- Habitat loss

Long-eared Owl frequent small conifer and mixed woods, as well as field groves, large parks and overgrown gardens (Felix, 1986). Barn Owl are mostly found in agricultural landscape. The habitat loss of the proposed windfarm would minimally impact on the population of owls, as there is ample similar habitat nearby, notably farmland and young coniferous woodland.

- Disturbance

Long-eared Owl lay eggs at the end of March or April, incubating for 27 to 28 days (Felix, 1986). Barn Owl are not particularly discriminating as to the time of nesting, and its clutch of 4 - 6 eggs may be found any time from March to November (Felix, 1986). Construction will obviously cause short-term disturbance if any owls are nesting nearby. However, there are no definite records of either species nesting in the locality. The normal operation of the turbines would minimally impact on both owl species.

Other bird species

Osprey favourite haunts are large, freshwater lakes and ponds, feeding mainly on fish, flying above the water's surface at a height of about 25 metres, often hovering for a while. On sighting prey, it plunges into the water with force. (Felix, 1986). This species occurs on the River Nore and is unlikely to venture near the windfarm site.

- Bird strike

Skylarks and Meadow Pipits display in the breeding season by flying high to advertise their presence in song. Skylark sing on the ascent, Meadow Pipit on the descent. In their song flight, the Skylark will invariably, and the Meadow Pipit will often, reach the height of the rotor blades. Also, Meadow Pipits indulge in aerial chases with erratic flight paths (EM Consultants, 1995). Again, wind turbines would pose a threat. Snipe have aerial song-flight which involves steep dives at elevations which could bring them near rotor blades. This takes place at night and is, therefore, a potential hazard (EM Consultants, 1995). Ravens and other crows are intelligent and will assess carefully any new phenomenon in their territories. It would be expected that they would avoid contact with the rotor blades (EM Consultants, 1995). Kestrels, our commonest bird of prey at 11,000 pairs (Cabot, 1995), hunt ground prey by hovering, or perching, on look-outs. They would be in a low-risk category. Sparrowhawk hunt mostly along hedges and woodland with a dashing, low, almost jinking flight. Therefore, the hill is not its preferred habitat and its low, alert flight would put it in the very low risk category.

- Habitat loss

The loss of habitat caused by the turbines and roadway is unlikely to be significant for any of the species above. Meadow Pipits and Skylarks will probably nest in the vicinity of the turbines if the habitat is maintained. Ravens and Kestrels are quite adaptable at utilising different habitat types, while Sparrowhawk would preferably hunt in the farm field systems at lower altitudes.

- Disturbance

Construction would cause disturbance to breeding birds in the vicinity. This would mostly impact on Kestrel, Meadow Pipits and Skylarks. Kestrels are quite adaptable, though and will move if necessary. The day-to-day operation of the wind farm and associated low level human activity would minimally impact on most bird species mentioned.

Mammal fauna

The day to day operation of the wind farm is unlikely to have a major impact on the ground mammal fauna. It is expected that the fauna present on-site will become accustomed to the movement and sound of the rotors. As long as human activity is not prolonged and intensive and is confined to turbine locations and on-site trackways, disturbance to the mammal population should be minimal. Any direct habitat loss will have a negligible impact on the viability of the faunal communities in the long-term.

Mitigation Measures : Fauna

Avifauna

- Bird strike

Peregrine Falcon, Long-eared Owl, Hen Harrier, Merlin, Kestrel and Sparrowhawk would not be expected to come in contact with the rotor blades. Skylark, Meadow Pipit, Snipe and Woodcock all may suffer bird strike. However, since these are common species, and the risk of collision low, the potential loss to their population would not be significant.

1. The possibility of bird strike can be mitigated by building the turbines of solid structure, rather than the alternative lattice design. This serves to restrict perching sites for raptors. This also means that vantage points for potential plunder of small birds' nests are not available for crows and ravens.
2. The placement of turbines will be such so as not to present a "wind wall" effect, where birds will have room to avoid turbines and thus reduce the potential for bird strike.
3. Turbines shall have low intensity navigation illumination, thereby reducing the potential for night-time, or low visibility bird strike.

- Habitat loss

Some of the wind farm site could be lost as foraging habitat for some species because they choose to avoid the area. At Ballymartin North, there are adequate areas of similar habitat in the vicinity, which could be utilised by these species. In terms of direct loss of physical habitat, the amount of habitat lost as a result of the presence of the wind turbines and associated infrastructure is relatively low. Mitigation measures for this potential impact are detailed under flora mitigation measures.

- Disturbance

Construction should be deferred until after the nesting season of Hen Harrier (April, May), ideally when bird fledglings have matured somewhat (June, July). However, at this site, although Hen Harrier nest nearby, it is over 2.5 km distant and it is expected that disturbance will not be a major factor. Once constructed, the daily operation of the wind farm will cause disturbance, due to the sound emitted by the turbines (mechanical and aerodynamic), the movement of the blades, and human activity. The sound disturbance factor is not regarded as

serious, both being at low audible levels. Similarly, the movement of turbine blades is not considered a major disturbance factor to the fauna present. The RSPB (1996) suggest that breeding birds habituate to the sound and normal operation of turbines. After construction, human activity will be confined to roadways and the wind turbines to minimise the human disturbance factor.

- General

With sensitive siting and design, wind farms will minimally effect biodiversity (RSPB, 1996). The risk of pollution arising from construction of the wind farm can be reduced by adopting the following preventative measures:

- off-site washing of concrete and cement carrying vehicles
- off-site disposal of excess concrete, used oils and other chemicals.

Please refer to a Hen Harrier activity report by Cork Ecology Ltd. undertaken during April and May 2008, included in the appendices.

3.3.2 Mammal fauna

- Habitat loss

Professional repair and replacement of any damaged or removed hedgerow.

- Disturbance

Not specific mitigation required.

References

- Benner, J., Berkuizen J. De Graff and Postma, A. (1993). Impact of wind turbines on birdlife. Report no. 9247. Consultants on energy and environment, Rotterdam, Holland.
- Cabot, David (1995). Irish Birds. Collins guide.
- Crockford, N.J. (1992). A review of the possible impacts of wind farms on birds and other wildlife. JNCC Rep. 27: 1-60.
- Dulas Engineeering Ltd. (1995). The Mynydd y Cemmaes windfarm impact study. Vol IID - ecological impact, final report. ETSU report : W/13/00300/REP/2D.
- EM Consultants (1995). Cark Wind Farm Proposal. Environmental Impact Report for B9 Energy and RES.
- Felix, J. (1986). The illustrated book of birds. Artia Prague.
- Fossitt, J. (2000). A guide to habitats in Ireland. The Heritage Council.
- Hawker, D. (1997). Windy Standard wind farm : breeding bird survey, 1997. Report to National Wind Power.
- Irish Birds (2002). National Survey of breeding Hen Harriers in Ireland, 1998 - 2000. Vol. 7, no. 1.
- Keighley Ecological Advisory Service (1993). Ovenden Moor Ornithological Monitoring. Report to Yorkshire Windpower.
- King, Frank (1994). Tursillagh, Co. Kerry E.I.S. Saorgus Energy Ltd., Tralee.
- King, F. (1997). Personal communication. Bird expert. Blennerville, Co. Kerry.
- Lloyd, A. (1996). Wind farm design in the light of previous experience. In: Birds and wind turbines, can they co-exist? Proceedings of a seminar organised by ETSU for the DTI, 26th March, 1996.
- Madder, Mike (1997). Personal communication. Bird expert. Tel. 0044 1496 850584.
- Percival, S. (1998). Bird and wind turbines : Managing potential planning issues. Proc. of 20 th British Wind Energy; Assoc. conference, 1998.
- Phillips, J.F. (1994). The effects of a windfarm on upland breeding bird communities of Bryn Tytli, Mid Wales, 1993 - 1994. RSPB report to National Windpower Ltd.
- Picozzi N. (undated). Studies of the Hen Harrier.
- R.S.P.B. (1996). Birds and wind turbines : RSPB policy and practice.
- Scottish Power (2003). Inverliever windfarm E.I.S.
- Watson, Donald (1977). The Hen Harrier. T & A D Poyser, Berkhamsted.
- Watson A. and O' Hare P.J., (1979). Bird and mammal numbers on untreated and experimentally treated Irish bog. OIKOS 33, 97 - 105 (Copenhagen).
- William, I.T. and Young, A.J. (1997). Trannon Moor ornithological survey, 1997. RSPB report to Powys County Council.

Effects on Archaeological Remains

Assessment Methodology

The material contained within the document is based on the *Guidelines on the Information to be Contained in Environmental Impact Statements* (E.P.A. 2002), and conforms to the methodologies recommended in 'Framework and Principles for the Protection of the Archaeological Heritage' issued by the Dept. of Arts, Heritage, Gaeltacht and the Islands (1999) and the Environmental Impact Statement Guidelines published by the Environmental Protection Agency (1995, 39-40). Section 3.6.6 of 'Framework and Principles for the Protection of the Archaeological Heritage' notes '*Environmental impact assessment should unless there are substantial grounds to show that it is not necessary, involve the carrying out of archaeological assessment including, where appropriate, test excavation*' (Dept. of Arts, Heritage Gaeltacht and the Islands 1999). All recommendations conform to the legislative frameworks of the *National Monuments Acts 1930-1994*, *Heritage Act 2000* and the *European Convention on the Protection of the Archaeological Heritage (ratified by Ireland 1997)*.

The archaeological survey works were carried out in accordance with relevant legislation and guidelines including:

- National Monuments Acts 1930-1994
- Heritage Act 2000
- Planning and Development Act 2000
- European Convention on the Protection of the Archaeological Heritage
- Framework and Principles for the Protection of the Archaeological Heritage
- Policy and Guidelines on Archaeological Excavation
- Architectural Heritage Protection – Guidelines for Planning Authorities 2004

Desk-top study

Primary sources

The Record of Monuments and Places for Co. Kilkenny was consulted for the relevant parts of Co. Kilkenny Ordnance Survey 6" Sheets 36 & 40. The relevant files for these sites, which contain details from aerial photographs, early maps, OS memoirs, OPW Archaeological Survey notes and other relevant publications, were inspected in the Sites and Monuments Records Office.

The following documentary sources were also examined:

a. National Museum of Ireland Topographical files and Registers
b. Griffiths Valuation (1849)
c. Census of County Kilkenny (1801, 1841, 1871, 1911)
d. Low level Aerial Photograph of area (Ordnance Survey)
e. Irish Schools Folklore Collections Microfiche Manuscripts Listerlin N.S.

Primary cartographic sources consulted consisted of Petty's Down Survey map of the Baronies of Knocktopher and Ida c.1685, 1st edition OS 1:10560 maps sheets 36 & 40 (1839), 2nd edition OS 1:10560 maps sheets 36 & 40 (1902), Discovery Series 1:50000 Sheet 76 and, the Records of Monuments and Places (RMP) constraints maps, County Kilkenny Sheets 36 & 40.

Secondary sources

Secondary sources employed are noted in the bibliography.

Digital Sources

A search of the website www.excavations.ie was undertaken. This provides summary reports of all licensed archaeological excavations carried out in Ireland between 1985-2000.

The website www.biab.ac.uk contains datasets covering publications from AD 1695 to the present day on archaeology and the historic environment, historic buildings, maritime and industrial archaeology, environmental history, and the conservation of material culture - with a geographical focus on Britain and Ireland.

Field Survey

Archaeological survey involved field inspection of the proposed development area. Each field was inspected and photographed. Recorded archaeological sites within close proximity of the proposed development area were visited. Pro forma record sheets were employed to record information on local topography, land use, areas of archaeological and/or architectural significance/potential and any folklore connected with the locale. A hand held GPS was used to plot locations of new possible sites encountered during inspection of the study area fields as well as to check the coordinates of those sites already known nearby.

The Archaeological Receiving Environment

General Historical & Archaeological Context

The development area lies within the townland of Ballymartin and the parish of Listerlin in the barony of Knocktopher, South County Kilkenny. The region is one of uplands; the granite massifs of Mt Brandon and Cullentragh hill to the Walsh Mountains and the foothills of Slievenamon at the west border with Tipperary. Land is predominantly poor farmland and bog. Unlike the rich farmlands of the north of the county this area is one with a far more rural feel and a much wider dispersed and smaller population.

The parish of Listerlin or Listerling as it was sometimes spelt is an ancient one and was so called in local folklore in reference to "a Danish fort or moat of considerable dimensions, surrounded by a ditch and fosse from which the Parish is supposed to have derived its name Lis-Easterling, the Fort of the Easterlings or Danes" (Tighe 1800, 631). O'Donovan however believes this to be an incorrect interpretation: "I am sure it is the place called Lis-ar-Glind in the Annals of the Four Masters at the year 1118" and therefore being simply translated as the Fort on the Valley (O'Donovan 1839, 170).

Prehistoric Context

Recent research carried out by the Ballylough Project in Waterford and Stout in Wexford has shown that during the Mesolithic period hunter-gatherers were present in the south-east of Ireland (Gibbons 1990). There is also partial confirmation of the presence of hunter-gatherers exploiting the resources of the rivers Suir, Nore and Barrow through the presence of materials associated with the later Mesolithic period such as Bann flakes from the Barrow valley in south-east Kildare. To date however, no unequivocal evidence of a mesolithic presence in county Kilkenny has been documented.

The Neolithic period sees the first concrete evidence of human settlement in County Kilkenny. All of the major megalithic tombs are represented and south Kilkenny in particular has a notable concentration of the sites with examples at Kilmogue, Farnoge, Ballynearla, Ballyvatheen and indeed a wedge-tomb (Site 3) is located 1km from the proposed development area in Ballymartin townland (Gibbons 1990). A fine example of a three stone alignment, known locally as the "three friars" (Site 2) lies less than 100m north of the proposed development area. Such sites are generally datable to the late neolithic-early bronze age and are rare in Kilkenny. Single standing stones are also quite common with examples recorded from Ballylusky, near Mullinavat and a possible new example was recorded within the proposed development area (Gibbons 1990). At Coolmore, south of Knocktopher, a flat cemetery was found with four short rectangular cists and at Ballynooney West, 2.5km west of the proposed development area, a cemetery cairn containing at least three cists was identified.

Early Historic Context

There are some 1200 Early Christian ringforts in County Kilkenny (Gibbons 1990). Of these twelve are located within 5km of the proposed development site including (Site 6) one approx. 1km from the propose development area in Smithstown townland. Local folklore stories of fairy forts are to be found in the Irish Folklore Commission's Schools Manuscripts: "Fairy forts are plentiful around the district. There is one in Darbystown in Nicolas Wood's field" (Listerlin National School 1838), and "there is a rath in a field belonging to Jack Harte of Darbystown" (Listerlin National School 1838). The National Museum of Ireland topographical registers record the discovery of iron slag fragments from a ringfort at Knockmoylan townland (reg. no. 1987:115). What may have been a souterrain is recorded by O'Kelly: "Ballymartin, Baile Mhairtin, Martins field.... area of 322 acres..... In the Kilkenny Archaeological Journal of 1849, it is recorded that a sepulchral vault to the south-west of Listerlin is locally called the Pooka's Grave..... In Carrigan's notes he also records it as Toomapooka i.e. Tumba an Phuca, also Moonashoga, i.e. Moin na Sidheog, moor of the fairies" (O'Kelly 1969, 173). Early ecclesiastical sites are found at some two-hundred locations in County Kilkenny (Gibbons 1990). St. Moling has left connections with the locality in placenames such as Mullenakill and there are possible early Christian ecclesiastical foundations at Mullinavat and Davidstown.

Medieval Context

The south Kilkenny uplands were peripheral to, though not entirely unaffected by the great economic and social transformations brought about by the Anglo-Normans conquest in the late 12th-13th century. The proposed development area was contained in the medieval cantred of Iverk, part of the Marshall lordship of Leinster. Attesting to settlement in the 13th-14th century are the moated sites at Smithstown approx. 1km from the propose development area (Site 4; Plate 3), Earlsrath and Ballytarsna and the boroughs established at Mullinavat and Knocktopher.

Modern Context

The 1st ed OS map (1839) of the townland shows a total of nine possible dwellings, with one of these appearing to lie within the development area. The overgrown remains and original plot of this development were noted during field inspection (field 1). By the revision of the 1st ed map in 1902 a new road had been built, bounding the east side of the development area running NE-SW and dividing the townland almost in half. Areas of the townland to the south and west were subdivided into fields not previously farmed, perhaps in an attempt to cultivate them. At around the same time perhaps, a trackway was built to the south of the proposed development area running E-W.

It does not appear as if this road and trackway nor the field divisions gave rise to new houses in the area as the total number shown had shrunk to two for the entire townland by the 2nd ed map. A dwelling is located to the south west of the proposed development area, the heavily overgrown remains of this was located during field inspection (field 17). A large homestead surrounded by trees lies to the E of the current development area. In 1801, the number of houses recorded in the census at Mullinavat was 35, with 158 inhabitants. The erection of a church here in 1805 led to an increase in population with 110 inhabited houses noted in the 1841 census. In 1871, the population of Mullinavat was 531. The 1911 census notes only three houses in Ballymartin townland with one family living in each. All the houses were listed as stone built with two being slated and a third (for the servants and labourers of the Woods family) being thatched.

Site Specific Historical & Archaeological Context

One previously recorded potential archaeological site, a possible standing stone was identified as lying within the proposed development area. This was located during field inspection in field 22 a flat field with gentle west facing slope (Site 1). The stone which appears to be sandstone, although has been recorded as possibly shale, is 1.32m high (max.) 0.92m wide at the base and has a thickness of 0.30m. The stone tapers to a rounded top. There is lichen and moss growth mainly to the west and on the top of the stone. Field inspection and aerial photography failed to identify any further previously unrecorded sites within the site. Five recorded

archaeological sites lie within 1km of the proposed development area, these include KK036:35 Stone Alignment (Site 2), KK040:37 Wedge Tomb (Site 3), KK036:3601 Moated Site (Site 4), KK036:3602 Dwelling (Site 5), KK036:37 Ringfort (Site 6).

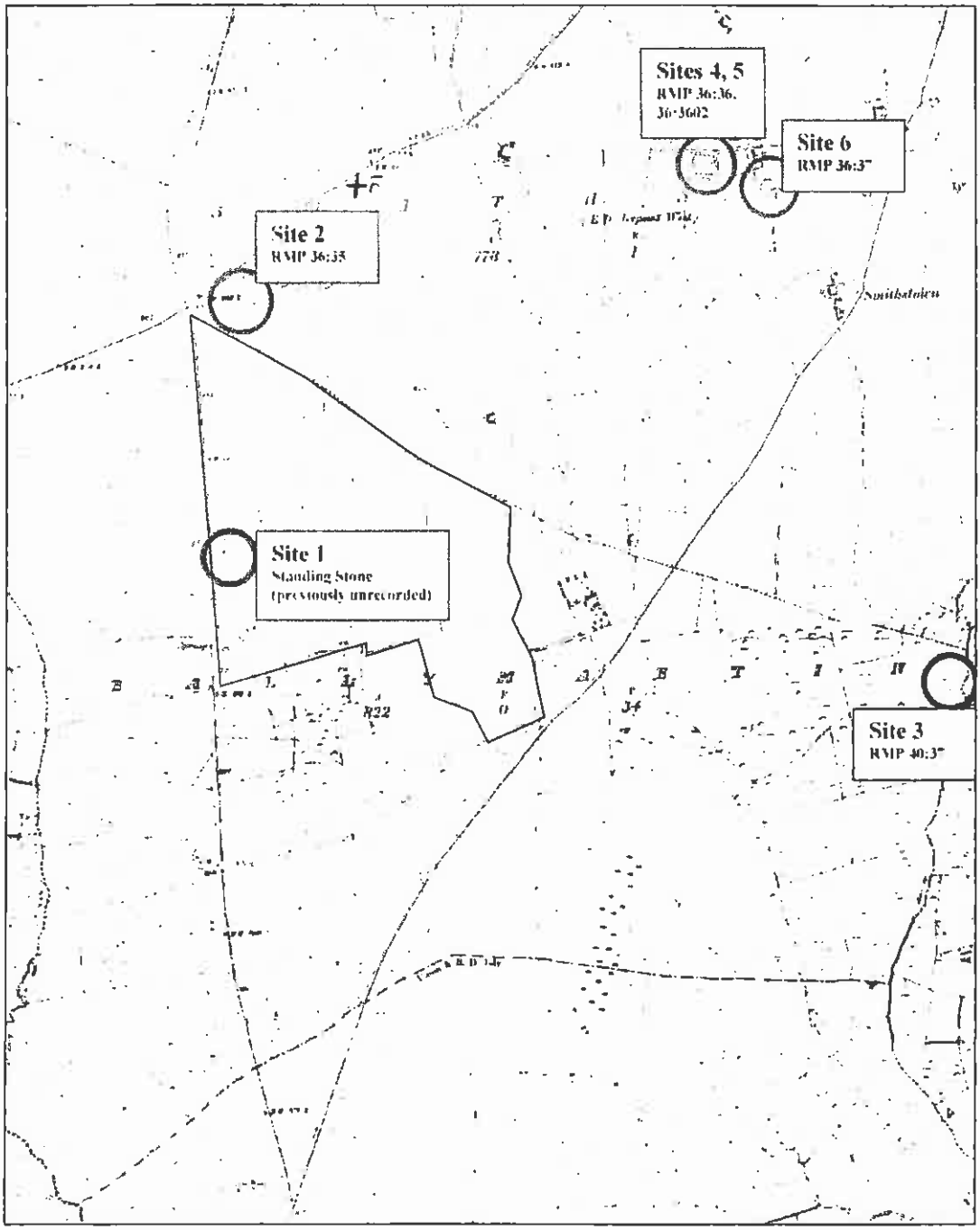


Figure1 : Proposed development area and position of RMP sites

Recorded Archaeological Sites

Site1

SMR NUMBER	Previously Unrecorded
COUNTY	Kilkenny
TOWNLAND	Ballymartin North
NGC	261109 126525
IDENTIFICATION	Field Inspection
TYPE	Standing Stone (possible)
DESCRIPTION	In flat field on gentle west-facing slope. Stone with a rectangular cross-section 1.05m x 0.80m. Stone-type possibly shale.
PROXIMITY	Within proposed development area
POTENTIAL IMPACT	The site is within the proposed development area and in close proximity to the proposed location of turbine T4.
MITIGATORY MEASURES	See Recommended Archaeological Mitigation Measures

SITE 2

SMR NUMBER	KK036:35
COUNTY	Kilkenny
TOWNLAND	Smithstown
NGC	260560 127680
IDENTIFICATION	SMR files, RMP, OS
TYPE	Stone Alignment
DESCRIPTION	Inspected 6th August 2003. Site appears on the 1st ed. OS map (1839). The stones are aligned N-S with size decreasing in the same direction. Three granite stones set 1.2-1.7m apart. The stones appear to have been whitewashed a number of years ago. They are situated about half way up a prominent ridge which runs N-S parallel to the alignment and the N-S facing valley in which they are located. About 10m below the alignment and respecting the curve of the ridge is a ditch of unknown date which partially encircles them. It is shown on the 1st ed. OS map. There has been a marker erected in honour of "the three friars" (as they are known locally) at the crossroads at the base of the hill to the NW (Plate 4). This is a reference to local folklore which equates the stones with three friars who were reputedly murdered by Cromwell's arm. A lime-kiln is also located in the NE corner of the field with a corresponding quarry at the NW side (Plate 5). They are both marked on the 1st ed OS map sheet 36, 1:10560.
PROXIMITY	100m from proposed development site
POTENTIAL IMPACT	Site is outside the proposed development area, and is not directly impacted upon physically.
MITIGATORY MEASURES	See Recommended Archaeological Mitigation Measures

SITE 3

SMR NUMBER	KK040:37
COUNTY	Kilkenny
TOWNLAND	Ballymartin
NGC	262290 126790
IDENTIFICATION	SMR files, RMP
TYPE	Wedge tomb
DESCRIPTION	Site could not be found during field inspection. Possibly destroyed by quarrying. Described by ASI: 'gallery aligned east-west incorporated in a low mound approximately parallel-sided in present condition. Overall dimensions 7.80m east-west, 4.60m north-south. Internal diameter 3.80m x 1.10m. Orthostats stand 0.30m high. Height of mound 0.90m a.g.l. Set on dry raised area in a boggy zone on west side of Arrigle river nearby at bottom of steep ravine. All grazing land or forestry.
PROXIMITY	1km from proposed development site
POTENTIAL IMPACT	No potential archaeological impact is predicted.
MITIGATORY MEASURES	No specific measures, see general recommendations.

SITE 4

SMR NUMBER	KK036:36
COUNTY	Kilkenny
TOWNLAND	Smithstown
NGC	261730 127980
IDENTIFICATION	RMP, SMR files, OS
TYPE	Moated Site
DESCRIPTION	Large rectangular moated site with a raised inner area and an outer enclosure to the south. Extant and in good condition. Heavily overgrown in parts so visibility was poor. Stream appears to be amalgamated with the enclosure all along the south side forming a wet ditch on the south side before it runs away again from the SE corner as a culvert and rejoins the stream. The area inside the trapezoidal shape made by the stream and culverts appears very flat and may be an enclosed area associated with the site. The site is situated 178m OD at the centre and a clear view of the surrounding landscape would have been possible when it was in use. Tory Hill is clearly seen to the SE. It consists of a raised central area of 30m square approx with internal low-lying banks visible in places. The enclosing ditch was 5m wide by 1.5m deep at west. Outside the ditch is a rectangular bank of stone (and some earth) of coarse boulders and large angular rocks. It lies along a gently sloping surface declining N-S
PROXIMITY	1km from proposed development site
POTENTIAL IMPACT	No potential archaeological impact is predicted.
MITIGATORY MEASURES	No specific measures, see general recommendations.

SITE 5

SMR NUMBER	KK036:3602
COUNTY	Kilkenny
TOWNLAND	Smithstown
NGC	261880 127930
IDENTIFICATION	RMP, SMR files, OS
TYPE	Dwelling
DESCRIPTION	Possible 17th century building shown on 1st ed. OS maps and associated with the Moated Site 36:36. The building consists of a rectangular stone built structure lying at the south side of the roadside and orientated E-W. The building materials were of large coarse boulders and some cut stone. It measures some 25m approx long E-W by 10m N-S the roofed is pitched and slated. Stone is well dressed. It appears to have comprised originally of a stables and two adjacent rooms as well as an attached outhouse. Construction materials were a mix of limestone and granite typical of the local bedrock types. The 1st ed OS map shows a second building running N-S which may have been the original dwelling with the remaining standing structure being the outhouses. There is no sign of this part of the structure and a newly built 4 span hay shed lies at this location shielding it from the development area.
PROXIMITY	1km from proposed development site
POTENTIAL IMPACT	No potential archaeological impact is predicted.
MITIGATORY MEASURES	No specific measures, see general recommendations.

SITE 6

SMR NUMBER	KK036:37
COUNTY	Kilkenny
TOWNLAND	Smithstown
NGC	261880 127930
IDENTIFICATION	RMP, SMR files, OS
TYPE	Ringfort
DESCRIPTION	Site levelled and barely visible. In 1989 when the ASI visited: the outline traceable in places. Ditch at south side is 5.3m wide (dark green grass) and [illegible] 0.2m deep. Ditch is visible for most of the eastern half of site. Field inspection proved further truncation had occurred [illegible]
PROXIMITY	[illegible] from proposed development site
POTENTIAL IMPACT	No potential archaeological impact is predicted
MITIGATORY MEASURES	[illegible]

Site field inspection

The field inspection was carried out on the 4th November 2007 in good dry but slightly overcast sunny conditions.

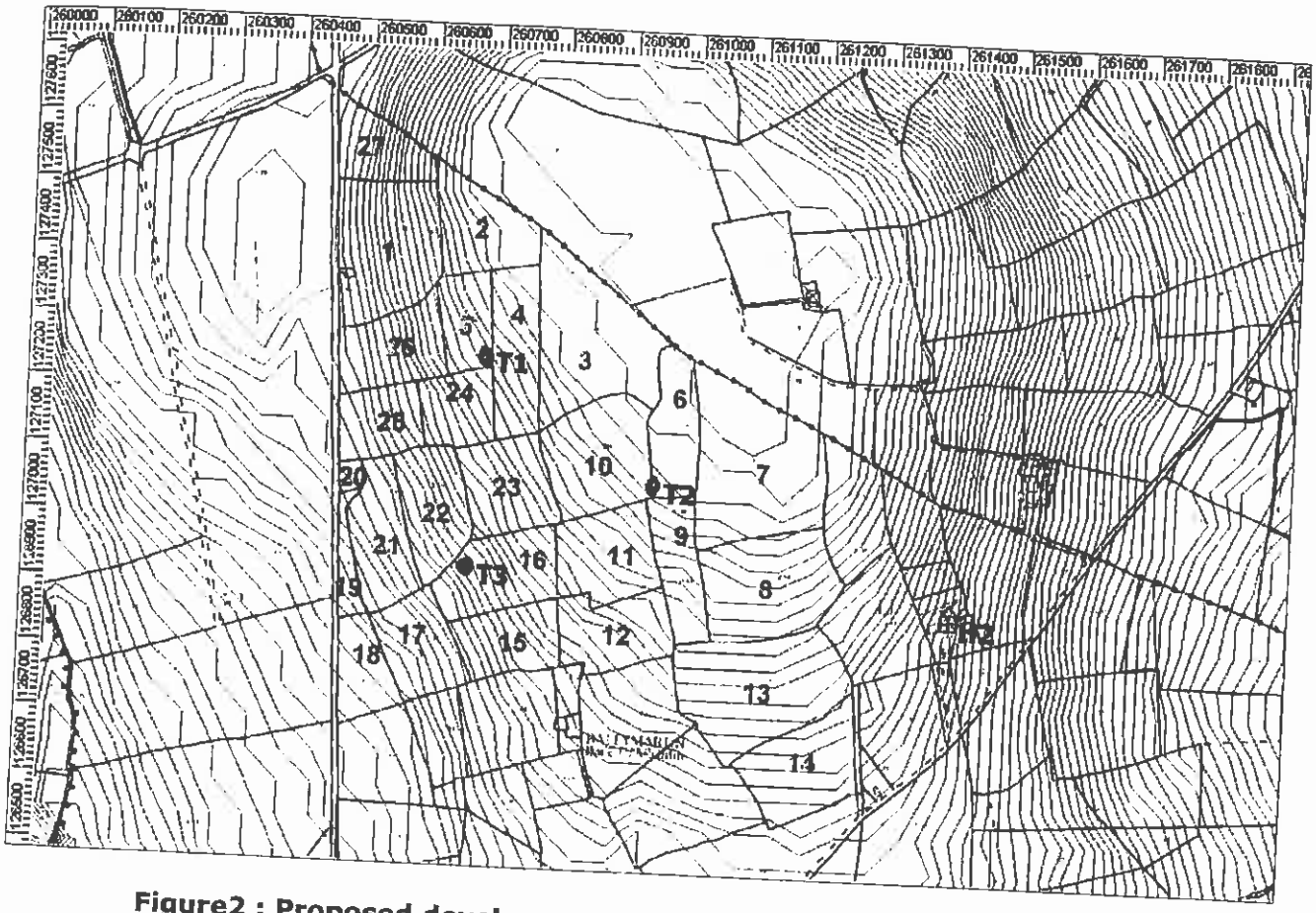


Figure2 : Proposed development site with field survey field numbers

Field #1 : Large field with moderate visibility. Moderately good pasture. Good surrounding views to NE-W-S. Field slopes from E to W. Bounded by hedge on top of stone banks and to W by the modern road. Oval area of rough ground with possible small track way leading to road and recently filled section of wall. Gateway towards road with one squared pier of rubble stone, one destroyed pier with an iron gate. This represents the site of a house indicated on the 1st edition OS map. Nothing else of archaeological potential noted.

Field #2 : Medium size trapezoid field under rough pasture. Moderate to poor visibility. Sloping moderately from E to W. Bounded by hedge and stone walls. Good views to S-W-NW. No features of archaeological potential noted.

Field #3 : Large trapezoid field with moderate visibility. Moderate pasture with some rough grass to NE of field. Gently slopes E to W. Good views to S-W-NW. Bounded by hedges and overgrown stone walls. Partial N-S running represents possible former boundary division within field. No features of archaeological potential noted.

Field #4 : Long narrow field with moderate to poor visibility. Poor marshy land with rough grazing. Good views to S-W-NW. Bounded by overgrown stone banks and hedges. The field is roughly divided in two, possibly an earlier division with better pasture to S. No features of archaeological potential noted.

Field #5 : Small rectangular field with moderate to poor visibility. Rough grazing with wet peaty patches. Good views to S-W-NW. Gently sloping from E to W. Bounded by overgrown stone walls and hedges. No features of archaeological potential noted.

Field #6 : Long narrow rectangular field on top of ridge. Relatively flat with reasonable good grazing. Good to moderate visibility. Good views to S-W, poor elsewhere. Bounded by overgrown stone walls. No features of archaeological potential noted.

Field #7 : Large trapezoid field on top of ridge with good visibility. Relatively flat with recently grazed moderately good pasture. Views good to S, reasonable elsewhere. Bounded by overgrown stonewalls and a row of trees between fields 6 and 7. No features of archaeological potential noted.

Field #8 : Medium size roughly rectangular field with good visibility. Quite flat field with slight slope to. Recently grazed good pasture, slightly sloping to SE. Views good to SE-S-W. Bounded by overgrown stone walls. No features of archaeological potential noted.

Field #9 : Long rectangular field with good visibility. Good pasture. Bounded by overgrown stone banks and hedges. Field slopes slightly to S. Good views to SE-S-SW No features of archaeological potential noted.

Field #10 : Large roughly squared field with moderate to good visibility. Moderately good grazing. Sloping slightly to SW. Good views to SE-S-W-NW. Bounded by overgrown stone banks and hedges. Proposed location of T5. No features of archaeological potential noted.

Field #11 : Roughly squared field with good visibility. Good pasture land, recently grazed. Good views to SE-S-W-NW. Slightly sloping to SW. Surrounded by overgrown stone banks and hedges. No features of archaeological potential noted.

Field #12 : Roughly rectangular field with moderate to good visibility. Reasonably good grazing Slightly sloping to W. Views good to SE-S-W-NW. No features of archaeological potential noted.

Field #13 : Large trapezoid field with moderate visibility. Good grazing under long grass. Reasonable flat field, sloping slightly to S. Views good to E, S and W. No features of archaeological potential noted.

Field #14 : Roughly rectangular field with moderate to good visibility. Flat field of good grazing. Good views all around except for to the N. No features of archaeological potential noted.

Field #15 : Roughly rectangular field with moderate to poor visibility. Mainly peaty land with rough grazing. Western half of the field slopes to the W. Bounded by overgrown stonewalls and trees in the N part. Good views to S-W-NW No features of archaeological potential noted.

Field #16 : Roughly rectangular field with moderate to poor visibility. Good recently grazed land. Slopes moderately to W. Good views from SW-W-N. No features of archaeological potential noted.

Field #17 : Medium roughly rectangular field with moderate visibility. Moderate grazing. Sloping towards W. In W part of the field there is a heavily overgrown squared area (ca 25 m by 25 m) which represents the remains of plot on which a house marked on the 2nd edition OS map was located, some heavily overgrown parts of remaining pieces of wall remain. No other features of archaeological potential noted.

Field #18 : Trapezoid marshy field (raised bog), heavily overgrown with ferns, heather and reeds. Poor visibility. Rough grazing in N part of field. Reasonable views to S-W-NW. Field

slopes slightly to W. A N-S running overgrown stone wall forms the boundary between fields 17 and 18. Evidence of trackway or roadway leading from the house plot in field 17 to a gate and stone piers accessing the roadway to the W of field 18. Possible large water trough inside gate. The gateway has one circular stone pier of random rubble stone (lime mortar) with a iron gate. No other features of archaeological potential noted.

Field #19 : Small and narrow trapezoid field with very poor visibility. Heavily overgrown boggy land. 2 groups of boulders in the middle of the field appear to be due to field clearance. Reasonable to poor views to S-W-NW. Field slopes slightly to W. No features of archaeological potential noted.

Field #20 : Very small squared flat field. Waterlogged and completely overgrown with trees and bushes. Western boundary is the modern road. Full inspection impossible due to wet land. Western boundary is the road. Surrounding views poor. No features of archaeological potential noted.

Field #21 : Long rectangular field with poor visibility. Under rough grazing. Sloping gently to W. Bounds marshy ground to W. Views reasonable to SE-S-W-N. No features of archaeological potential noted.

Field #22 : Large roughly rectangular field with moderate to good visibility. Under moderately good grazing. Gently sloping to W. Views fairly good from S-W-NW. Standing stone in W part of field (Site 1), possible sandstone, 1.32m high, (max.) width at base 0.92m and thickness 0.3m, rounded on top. Possible standing stone located approx. 30-50m north of proposed location of turbine T4 which is proposed to be constructed in this field.

Field #23 : Roughly squared field with moderate to good visibility. Under reasonably good grazing. Sloping gently to W. Views good from S-W-NW. No features of archaeological potential noted.

Field #24 : Roughly squared field with poor visibility. Very rough grazing and reeds, peaty ground. Gently sloping to W. Views good from SW-W- NW. No features of archaeological potential noted.

Field #25 : Roughly squared field with moderate visibility, poor to west. Flat on E side, slopes from middle of field to W. West end of field is overgrown and waterlogged. Views good S-W-NW. West end of site bounded by the modern road. No features of archaeological potential noted.

Field #26 : Large roughly rectangular field with moderate visibility, poor to west. Fairly good grazing except marshy area to W. Gently sloping to W. Views good S-W-NW. West end of field slopes to W. West end of field bounded by the modern road with iron gate. No features of archaeological potential noted.

Field #27 : Triangular shaped field with moderate visibility with rough grazing, sloping fairly sharply West. Reasonable views to S, N and W. 3 friars stone alignment and memorial stone are located in the field directly north of field 27. No features of archaeological potential noted.

Field Inspection Results

The archaeological survey identified one monument of archaeological significance, a possible standing stone, situated in Field #22 and in close proximity to the proposed location for the construction of one of the turbines. The remains of two dwellings of 19th–early 20th century date were also identified in Fields #1 and #17. Given the elevated location of the majority of the proposed development site the prominent position of a large number of the fields, and the number of archaeological remains within and surrounding the area the development area as a whole would be considered to be of moderate archaeological potential.

Archaeological Impact Statement

An archaeological impact assessment was undertaken on behalf of the client as part of a planning application for a proposed 3 turbine wind farm at Ballymartin North, Mullinavat, Co. Kilkenny. The assessment comprised of a desk-top assessment and archaeological field survey.

Desk-top study indicated the site was of moderate archaeological potential due to the location of the development area within a landscape rich in archaeological sites of late prehistoric and medieval date with a number of sites of archaeological significance being located in the surrounding area.

Archaeological field survey comprising of field inspection and aerial photography analysis. Field inspection noted the presence of the previously recorded possible standing stone (Site #1). The remains of two dwellings of 19th–early 20th century date identified in Fields #1 and #17 are of no archaeological significance. Otherwise, no further previously unidentified sites of archaeological significance were found within the development area.

Recommended Archaeological Mitigation Measures

1. Given the presence of a possible unrecorded standing stone (Site1), it is recommended that a 50m buffer be placed around this site and no positioning of turbines or any associated infrastructure within this area.
2. It is recommended that a programme of archaeological test excavation be undertaken of the proposed development footprint prior to the construction phase of works. The development footprint includes the construction of access routes, pads for the wind turbines, below-ground electrical piping, pads for electricity poles and associated works. Archaeological test excavation is defined as: 'that form of archaeological excavation where the purpose is to establish the nature and extent of archaeological deposits and features present in a location which it is proposed to develop (though not normally to fully investigate those deposits or features) and allow an assessment to be made of the archaeological impact of the proposed development' (Framework and Principles for the Protection of the Archaeological Heritage 1999, 27). An archaeological testing methodology will be agreed prior to commencement with the archaeological licensing section of the Dept. of the Environment and the National Museum of Ireland.
3. No site offices, depots, storage facilities should be placed on or within 30m of any of the recorded monuments.
4. Construction traffic must not be allowed on or within 30m of any of the recorded monuments, unless on an existing road.
5. Spoil should not be dumped on or within 30m of any of the recorded monuments.

Bibliography

Basset, G.H.	1884	*Kilkenny City and County Guide and Directory*. Grangesilvia Publications, Kilkenny.
Carrigan,Rev. W.,	1905	*The History and Antiquities of the Diocese of Ossory,* 4 vols. Dublin.
Curtis, E	1938	*A History of Medieval Ireland.* Meuthen.
Gibbons, M.	1990	'The archaeology of early settlement in county Kilkenny', In W.Nolan and K.Whelan (eds), *Kilkenny: A History and Society. Interdisciplinary essays on the History of an Irish County,* 1-32. Dublin.
Healy, W.	1893	*History and Antiquities of Kilkenny County and City,* 2 vols. Kilkenny.
Lewis, S.	1846	*A Topographical Dictionary of Ireland.* London.
O'Donovan, J.	1835	*Letters containing information relative to the Antiquities of the County of Kilkenny collected during the Ordnance Survey in 1835 vol.1*. (Printed 1930).
O'Kelly, O.	1969	*The placenames of County Kilkenny*. KAS, Kilkenny (reprint 1985).
Prim, G. A.	2003	*Nooks and Corners of the County Kilkenny.* Grangesilivia Publications, Kilkenny (reprint).
Smyth, W.	1990	'Territorial, social and settlement hierarchies in seventeenth century Kilkenny' in W.Nolan and K.Whelan (eds), *Kilkenny: A History and Society. Interdisciplinary essays on the History of an Irish County,* 1-32. Dublin.
Tighe, W.	1800	*A Statistical Account of Kilkenny*. Dublin.

Note: All recommendations are based on information supplied by the client and are subject to the approval of Kilkenny County Council and the Department of the Environment, Heritage and Local Government.

Coilin Ó Drisceoil

Cóilín Ó Drisceoil MA, MIAI
Kilkenny Archaeology
Unit 11, Abbey Business Centre,
Abbey St., Kilkenny City
12th Nov. 2007

The Ballymartin North site is underlain by the Ballylane Formation, a green & grey slate with thin siltstones (GSI Sheet 23, OABYLA), a member of the Lower-Middle Ordovician greywacke sequence consisting of sandstones, conglomerates and slates. The bedrock is at surface or is covered by a thin overburden of unconsolidated in-situ regolith and shallow peaty gleys. All coarse grasslands are moderately grazed.

Mean site surface gradients & azimuths at proposed infrastructure locations:

ID	Easting	Northing	Gradient	Azimuth
T1	238005	170520	3.27 degrees	235
T2	238305	170520	2.45 degrees	226
T3	238158	170260	4.09 degrees	236
Anemometer	238360	170400	2.40 degrees	244
Sub-station	238380	170460	3.27 degrees	225

The sole effect of the proposed project on the on-site bedrock and soil will be during the temporary construction stage. The foundations for the proposed three turbines will entail the excavation of approximately 1900 cubic metres of material comprising bedrock and soil overburden. The slate bedrock is an abundant rock type and the effects on the local resource will be negligible

Geological & Geotechnical Assessment:
The site is underlain by the regionally common fine-grained, green & grey slate with thin siltstones. The bedrock has a high clay content, which imparts a hard texture to the rock while retaining a high structural strength (rheology). No significant large-scale structural feature or fracturing is evident on site. The bedrock is overlain by in-situ regolith and shallow peaty gleys which are likely associated with the underlying bedrock. The bedrock is at surface.

Slope Stability Risk Assessment:
The wind farm site is located on a broad gently rounded hill with a south-westerly aspect and a topographic high point of 230m. Gradients of ground level are low to moderate, with a site mean of 3.03 degrees and a maximum gradient of 4.09 degrees at T3 - see table above.

Given the [illegible] site gradient of less than 4.5°, the competent nature of the bedrock [illegible] and a shallow soil overburden, construction of the proposed site [illegible] any surface slope stability issues.

[illegible]

The site is not near any areas of significant mineral or aggregate potential.

The project will not export any volume of mineral aggregate from the site.

It is envisaged that all bedrock and soil material excavated from turbine bases will be consumed in access track construction and site re-instatement. The immediate vicinity of the turbine base and crane hardstanding will be professionally re-habilitated after the installation of the turbines. The full utilisation of spoil in road construction and post-construction site re-instatement will ensure that accumulations of rubble do not have an adverse effect on the appearance of the site and will not produce any site stability issues.

Effects on Water Quality

The existing environment

The surface drainage patterns at the Ballymartin North site are largely dictated by surface gradient and field drainage boundary ditches. Surface water is of high chemical and biological quality due to the low level of intensive agricultural activity on the site. The remote location and the lack of development make the likelihood of contamination of groundwater aquifers from domestic, agricultural or industrial sources remote. The land is used for rough grazing.

The nearest permanent watercourses are approximately 700m southwest (south flowing) and 1.5km east (north flowing). The site is located in a Groundwater Vulnerability Zone of 'Extreme (Rock near surface\karst)' as defined in Map 6 in Appendix E of the Kilkenny County Development Plan 2008-2014. A Groundwater Protection Scheme is enforced by Kilkenny County Council.

The potential effects of the proposed project

The main potential effect to the local and regional water resources from this project is during the construction phase if runoff from earthworks brings large amounts of suspended solid matter into local streams and regional rivers. The excavation of turbine bases will result in water gathering in the resulting hole. This will be displaced as the hole is back filled with hard core and concrete. This relatively small volume of water will slowly spread out on the surface of the land where it will dissipate harmlessly.

Due to the presence of the impermeable slate bedrock and lack of surface fracturing, there will be little threat to the local groundwater resource during the construction phase.

After construction, the operation of the wind farm will have no impact on the site's water quality. The potential of surface or ground waters from contamination by spillage of turbine lubricants or vehicle fuel during maintenance is negligible.

Measures to lessen adverse effects

No streams will be traversed by on-site infrastructure.

Earth moving contractors will be required to ensure that their methods do not allow excessive soil run-off during the construction phase in the vicinity of streams (<50m). This may require temporarily blocking any run-off to adjacent streams with simple straw-bale sediment traps so as to collect the runoff and to allow for slow discharge.

In addition, spoil temporarily stored on site will be located in areas where release of suspended solids into waterways is not possible. This will be overseen by the developer.

During the construction phase, fuel will be temporarily stored in steel or plastic tanks with 110% bunded capacity. Any minor spillage of lubricants or fuel either during or after construction will be removed from the site along with any affected soil and disposed of in accordance with best industrial practice.

Effe...

The Ballymartin North wind farm does not lie in the ... rt for B9 Energy
traffic. Therefore, the development of the wind farm v...
region's aviation traffic. The developer will fully com... ne contained in
requirements for aircraft warning lighting which may ...
decision.

for Planning

Effe...

There are no known aspects of the local cultural heritage that ...
the proposed development. Examples of such aspects could inclu...
historical or traditional event and location of famous events in ...
aspects are known to the developer after local enquiries.

l Public
nt

Inte...

It is considered that there is little potential for special cumulative effects ... 278 00
of the environmental effects described above or for significant exacerba...
The visual and sound aspects will interact to a certain extent for those wh...
the site. However, the sound aspect is considered to be minor when comp... ne 6;
effect and therefore the interaction of the two is not likely to be significant.

Similarly, the other residual effects are considered to be minor and show litt... · 22
interactions leading to new negative effects. In addition, it can be stressed tha...
projects such as this do not pose worst-case scenario effects that lead to irreversi... ---
a severe nature such as contamination of an aquifer or destruction of a unique habit...

rence List

onsultants (1995). *Cark Wind farm Proposal*. Environmental Effect Report for B9 Energy ES.

Environmental Services Ltd. (2002). Guidelines on the information to be contained in onmental Impact Statements. Environmental Protection Agency.

ds of the Earth (1995). Planning for Wind Power (2nd Ed.).

Department of Environment (1996). Wind farm Development; Guidelines for Planning ority.

Planning Institute (1995). Planning Guidelines for Wind Energy.

Wind Energy Association (1996). Power From the Wind.

n, Soren. 2000. Danish Wind Turbine Manufacturers Association web site; r.windpower.dk.

, Jonathan, Spengler, John D., Hlinka, Dennis and Sullivan, David, 2000. Estimated Public th Effects of Criteria Pollutant Air Emissions from the Salem Harbor and Brayton Point er Plants. Report of Harvard School of Public Health. www.hsph.harvard.edu

iton, C. (1996). The Landscape Effect and Visual Design of Wind farms. ISBN 1 901278 00

Department of Environment, Scottish Office (1994). National Planning Policy Guideline 6; ewable Energy.

Department of Environment, Welsh Office (1993). Planning Policy Guidance Note 22 nmonly known as PPG22).

Appendices