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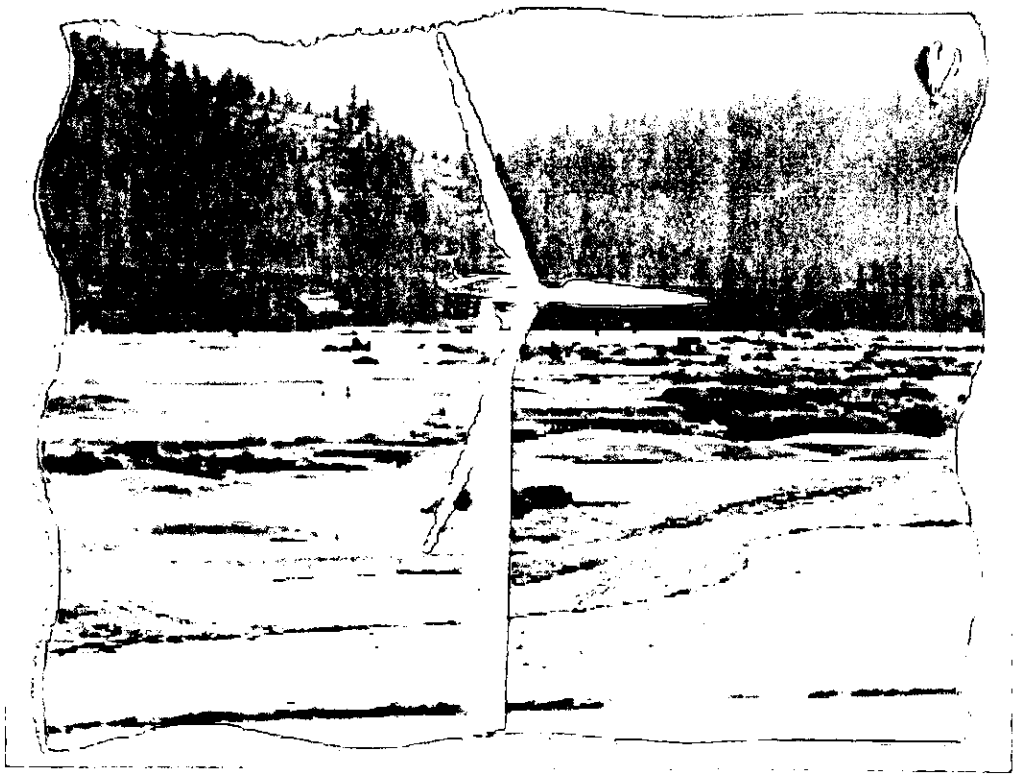
ENVIRONMENTAL IMPACT STATEMENT FOR TOORNAFULLA WIND FARM AT TEMPLEGLENTAN EAST GLENMORE WEST, KILLACULLEEN, CO. LIMERICK.



Prepared for:
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FEHILY TIMONEY & COMPANY

ENVIRONMENTAL IMPACT STATEMENT

FOR

A PROPOSED WIND FARM

AT

TOORNAFULLA

CO. LIMERICK

NON-TECHNICAL SUMMARY

Volume 1 of 3

Prepared for: -

Eirtricity Developments,
Burton Court,
Burton Hall Road,
Sandyford,
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Prepared by: -

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February 2001

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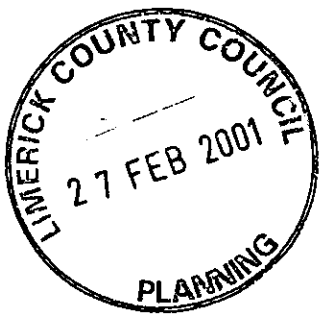

NON-TECHNICAL SUMMARY

Volume 1 of 3

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PREFACE

This Environmental Impact Statement has been prepared for Limerick County Council in support of a planning application submitted by Eirtricity Developments Ltd. for a wind farm comprising 17 turbines, site tracks and foundations, meteorological mast, electrical compound, temporary site works and all ancillary development. The connection of the site to the national electricity distribution network including the specification and details of the route will be the subject of a separate application by the National Grid operators.

The Environmental Impact Statement comprises three volumes. Volume 1 is the Non-Technical Summary, Volume 2 identifies the assessments undertaken with respect to the development proposed together with details of the development and Volume 3 contains associated appendices.

The report is being submitted to Limerick County Council in order that the Planning Department, the County Council, local people, statutory and non-statutory bodies have full details of the proposed development.

The site has been selected following a screening process involving technical, economic and environmental criteria.

1 INTRODUCTION

1.1 The Proposed Development

The proposal is to construct a wind farm in Toornafulla situated about 8 kilometres south-east of Abbeyfeale. The location of the proposed development is shown on Figure 1. The development will involve 17 wind turbines, spread over an area of approximately 184ha as shown on Figure 2. It will also entail the provision of access tracks to the turbines and electrical substation to connect to the ESB grid. A 50m meteorological mast of lattice construction will be also erected on-site. The wind farm will generate electricity that will be transmitted to the ESB transmission network to meet local demand in the Limerick Region

1.2 Promoters

The applicant is Eirtricity Developments Ltd., the site development section of Eirtricity (a joint venture company between Future Wind Partnership and National Toll Roads). Future Wind Partnership was set up 3 years ago with the aim to develop Ireland's wind energy resources. The promoters are involved with the development of other wind farms in Ireland. These have either been commissioned or are at various stages in the planning process.

1.3 The Technology

The development will utilise the most modern and technically advanced wind turbines. The Lagerway 70/1500 turbine is self-erecting requiring only one crane on site and for a shorter period than for conventional turbine installation. An advantage of the Lagerway turbines is their low level noise emissions relative to other turbines of similar size and generating capacity. In addition, the electricity produced by the direct drive turbines in of high quality, which has the advantage of strengthening the local grid.

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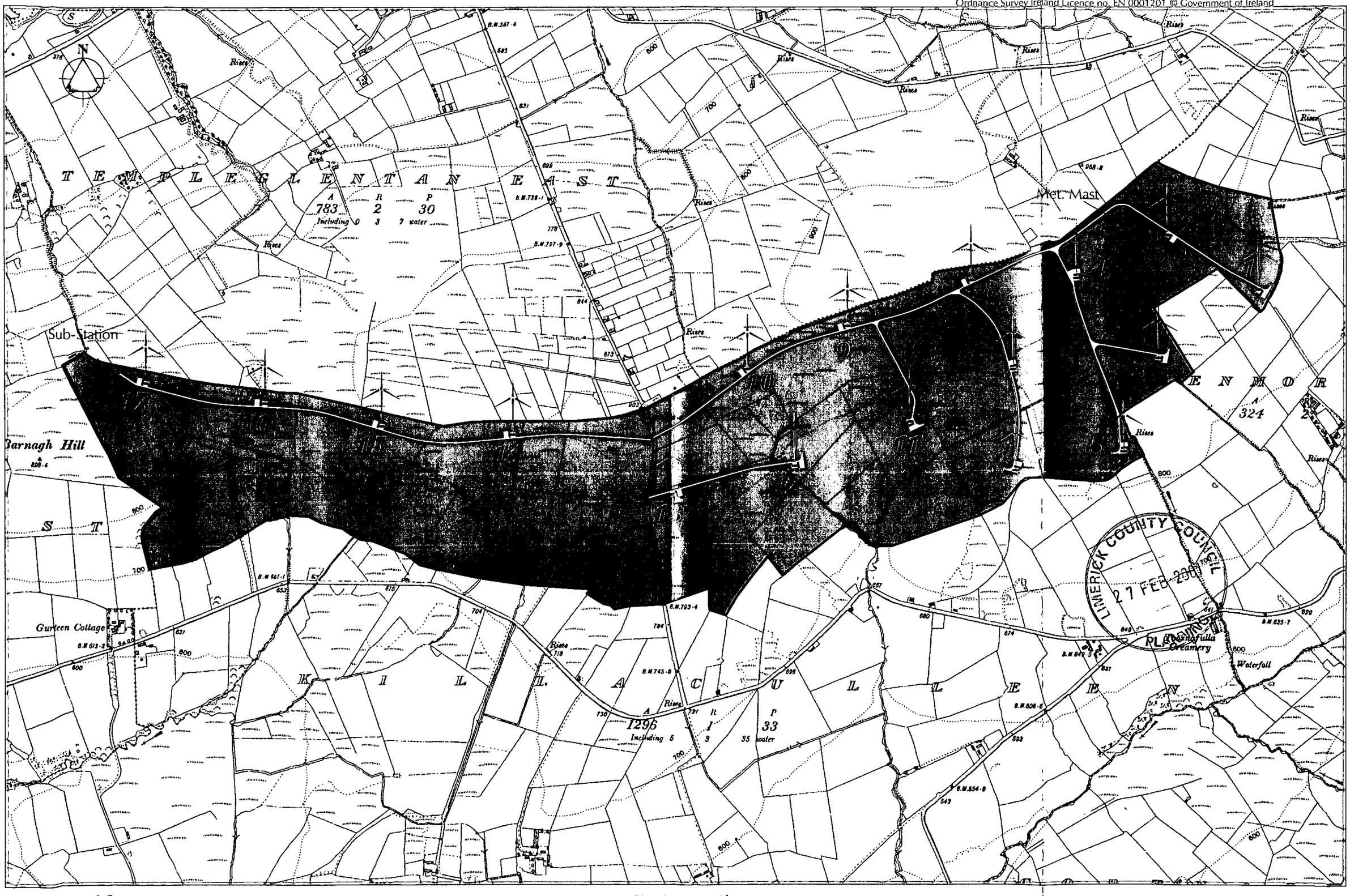

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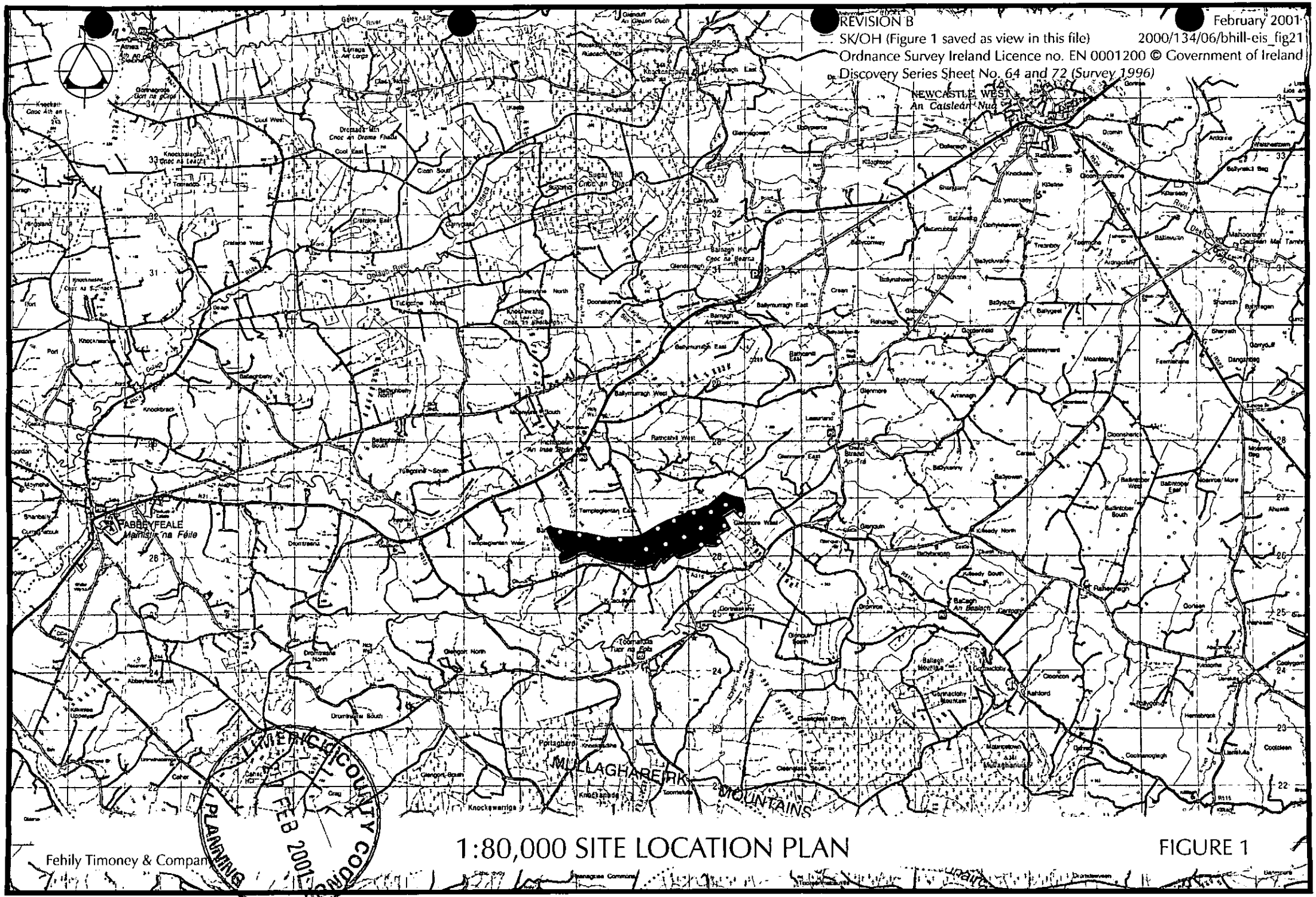
1:10,000 Site Layout Plan

FIGURE 2.



1:80,000 SITE LOCATION PLAN

FIGURE 1

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1.4 The Site

As part of this proposal, a detailed site selection process was undertaken, resulting in the choice of Toornafulla. Wind monitoring carried out over the past 2 years indicate that the location is suitable for wind energy developments (average wind speeds of 8.1m/sec). The site is located between Abbeyfeale and Newcastle West and therefore has access to high electricity demand.

Access to the site is good also. Only minor road alterations may need to be made.

The area is not subject to any statutory designations for wildlife conservation purposes; it is not a National Heritage Area (pNHA), a Special Area of Conservation (pSAC) or an area of visual or scenic importance.

The site is owned by six local landowners. The land is currently used for pasture and cattle grazing. The landowners will benefit from the sustained rental income and the local communities of Toornafulla and Templeglentan will benefit from an annual financial contribution from Eirtricity, estimated at £25,000.

The housing density within 1km of the turbines is relatively high. There are 50 houses located within a 1km offset from the turbines. The majority of the housing is located along the R515, which runs less than 1km to the south of the site. Some housing is also located along the road dividing the site (Lots Road) and along the road to the north-east of Lots Road. The development will impact on these locations. A map showing the nearest residences is provided as Figure 3.

1.5 The Main Benefits

National Economy

Due to the continuation of the economic boom, demand for electricity in Ireland has been rising at a rate of 5% per year. A significant shortfall in electricity supply has been identified. Unless new electricity generation capacity is put into place, demands for electricity at peak periods in excess of available supply will have negative effects on the local community.

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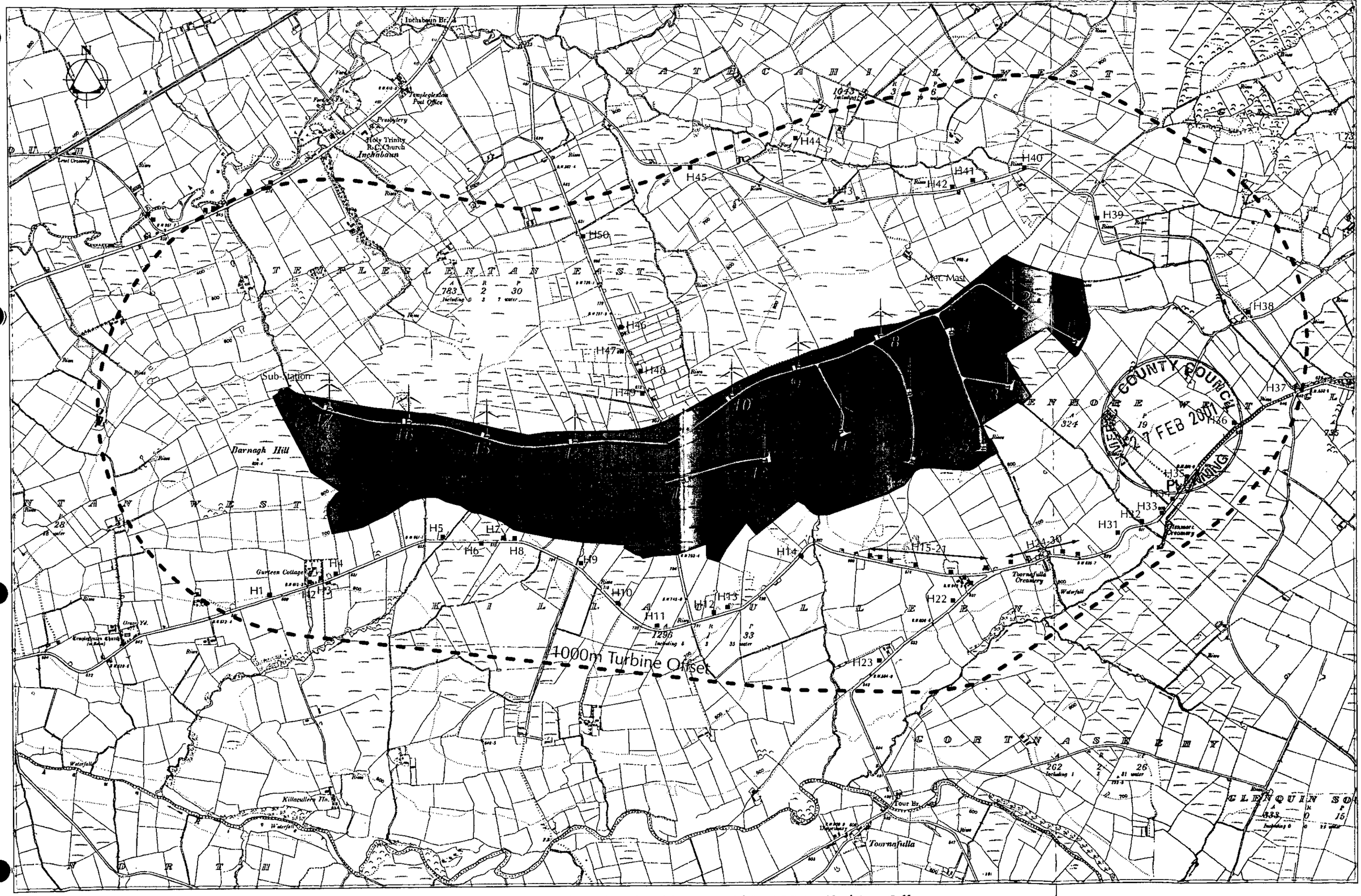


Fehily Timoney & Company

1:15,000 Site Layout Plan Showing Houses within 1000m Turbine Offset

FIGURE 3.

Wind energy is a particularly attractive source of electricity generation because it: -

- does not produce emissions of carbon dioxide normally associated with burning fossil fuels;
- avoids the need for the importation of fossil fuels, thus providing a significant positive contribution towards the balance of payments; and
- is seasonally variable, with the greatest volume being generated in the winter, a time when demand is highest.

Distribution of the energy produced at this wind farm will be highly efficient, as line losses will be minimised due to the proximity of centre of demand populations.

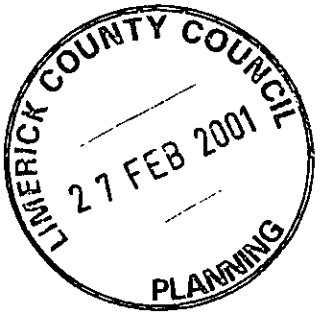
Local Economy

During the construction phase, significant commercial opportunities will arise for local enterprise. Approximately 20 people will be employed on-site during the construction phase. Involvement by local based companies in the construction and operation of the wind farm could have long-term economic benefits in that acquired technical expertise could be applied to other projects in the developing Irish wind farming industry. Participating landowners will benefit from long term annual rental income indexed to inflation. One to two part-time caretakers will be employed to over see the wind farm.

The promoting company is to contribute to the local community an annual income of 1% of the gross earnings to be divided between the parishes of Toomafulla and Templeglentan. The construction of proposed 26MW wind farm would result in an annual income of £25,000 to be divided between the parishes.

Experience in the UK suggests that wind farms have the potential to generate tourism in their locality (Delabole, Cornwall). As there are no other wind farms in Limerick to date, it could be expected that the development would encourage visitors to the area. Being very close to Newcastle West, one of the largest towns in Limerick, day visitors would bring positive benefits to the local economy.

In addition, the development will result in a rates income to the County Council. This will be substantial additional income for the Council, which will be out to beneficial use in other areas of the county.



Environmental Benefits

This project has significant environmental benefits, derived mainly from the generation of electricity using technology that does not involve the combustion of fossil fuels. It is estimated that this wind farm would avoid the production of approximately 72,000 tonnes of greenhouse gas emissions per year.

1.5.1 Environmental Impact Statement

This Environmental Impact Statement (EIS) was prepared by Fehily Timoney & Co. (FTC). The assessment covered a wide range of environmental aspects including landscape and visual character, human beings, noise, hydrogeology, hydrology, archaeology, land use, material assets, traffic and ecology. The effects on human beings were given considerable attention, particularly with regard to potential noise and shadow flicker. Visual impact was given particular attention, and care was taken to reduce the impact of the development from a range of selected key viewpoints.

Wind farms are normally located on exposed landscapes due to their technical requirements for wind speed and consistency. While the visual impact of wind farms cannot be eliminated, good design practice will ameliorate adverse visual impacts for most residents living within the visual envelope of the development. However, residents living within 2km from any turbine may be subject to more significant visual impacts. Other effects, such as noise, shadow flicker and traffic are discussed later in this document and fully considered in the main volume of this Environmental Impact Statement.

A detailed landscape impact assessment has been carried out for the proposed development. The conclusion drawn from this assessment is that the landform and character is suitable for the development proposed.

1.6 Public Consultation

In the course of the preparation of the EIS, a number of organisations and individuals were consulted. An information package was developed to provide details of the proposal and to gauge local reaction. A public information exhibition was held in Toornafulla Community Hall on the 16th February. The meeting attracted huge local interest and on the whole feedback was favourable. A number of concerns were raised particularly regarding noise and electromagnetic radiation by residences living closest to the site. These aspects of the development are discussed in a later section.

The local landowners and developers have also carried out an extensive local information campaign concerning the proposed development with the assistance of local community interests. All households within a 1km radius of the wind farm were called on with a view to providing information, discussing the project and assessing local reaction.

In the course of the preparation of this Environmental Impact Statement, a number of organisations and individuals were consulted. These are identified in the main EIS document. A meeting with Limerick County Council Planning Department was also held during the course of the preparation of the planning application.

1.7 Scope of this EIS

The scoping of this document has been prepared in accordance with the requirements of national legislation and applicable guidelines.

1.8 Contributors

The EIS was co-ordinated by Fehily Timoney & Co, Core House, Pouladuff Road, Cork. In addition, the following consultants were commissioned to undertake specialist assessments as follows:

Aquatic Services Unit, UCC - Bird Survey;

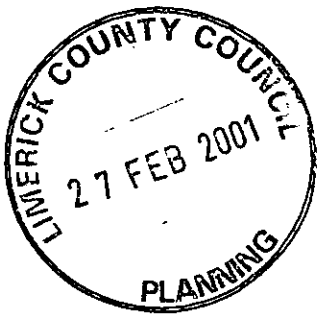
1.9 Format of this EIS

The report is submitted in three volumes:-

Volume 1: Non-Technical Summary

Volume 2: Main Report

Volume 3: Appendices



2 WIND ENERGY IN THE CONTEXT OF NATIONAL POLICY

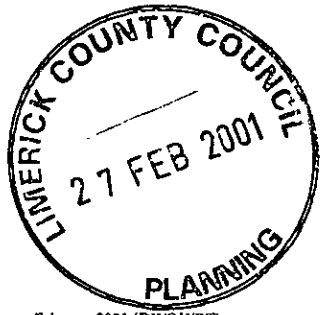
2.1 Introduction to Wind Energy

The security of national energy supply is one of the most significant challenges facing any economy that does not have adequate indigenous energy resources. A parallel priority objective is the need to protect the global environment from damage caused by energy consumption activities.

The Irish economy is expanding rapidly and already the electricity supply demand balance is very tight. Additional generating capacity must be developed. Between 1990 and 1998 electricity demand grew by 48%. It is estimated that demand will grow another 32% from present levels by 2010. Additional electricity generating capacity must therefore be developed as a matter of urgency.

Traditionally, electricity has been generated mainly by the burning of fossil fuels such as oil, coal, gas and peat. This activity results in significant emissions of carbon dioxide into the earth's atmosphere. In the past decade, it is has been established that these emissions remain in the atmosphere. When combined with sunlight, the increasing volumes being emitted are causing the average temperature of the planet to increase. This phenomena is known as global warming. Ireland could experience higher winter rainfall with more severe flooding, lower summer rainfall and water shortages, rising sea levels, accelerated coastal erosion and loss of bogland due to climate change.

Commencing in Rio in 1992, national governments have collaborated in a series of meetings and consultations on the global environment and climate change culminating in the Kyoto Protocol in 1997. Ireland has participated in this process and has agreed to limit increases in greenhouse gas emissions to 13% of 1990 levels. The agreed national target for Ireland is proving extremely challenging, particularly in the light of more recent economic growth and the associated increase in the demand for electricity. Already the emissions target has been exceeded.



The production of electricity using wind energy as a sustainable energy source is strategically important in Ireland's energy policy. In the last fifteen years wind turbine technology has matured and costs have reduced significantly. Ireland is well placed to benefit from wind energy, as it enjoys sustained periods of high wind speeds from a single predominant direction. When these factors are viewed in the context of the need for non-fossil fuel energy generation and the national greenhouse gas emission targets, wind power becomes particularly important in the Irish energy portfolio.

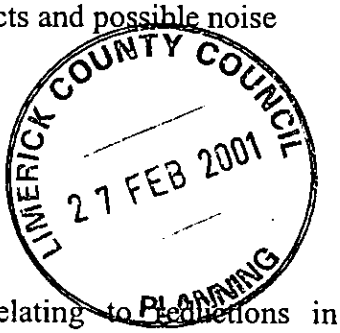
Like any other human activity, wind energy impacts on the environment and has associated costs and benefits. These must be carefully analysed so that the locations of the turbines are appropriate and serve the needs of the community as a whole.

In summary, the benefits of wind energy include:

- reduction in the level of greenhouse gases emitted to the atmosphere, thereby contributing towards the attainment of national emission targets;
- abatement of other pollutants and environmental protection;
- reduction in energy importation, use of an indigenous resource, security of energy supply, and improvement in the national balance of payments;
- local economic benefits; and
- an overall contribution to sustainable development.

Generally, two types of cost are associated with wind energy:

- economic – capital and operational costs and displacement of other economic activities; and
- environmental – minor land take, habitat loss, visual impacts and possible noise effects.



2.2 National Policy

Besides the requirements of the international agreements relating to reductions in greenhouse gas emissions, Ireland has set a target of 500MW (megawatts) of installed generating capacity from renewable sources by 2005 – about 11% of total national electricity capacity. Large scale wind farm developments have been identified as the most effective means of harnessing Ireland's full wind energy potential. In addition, the Electricity Regulation Act 1999 provides for the liberalisation of the electricity market for renewable energy suppliers. Eirtricity has been active in this market and since February 2000 has attracted over 6,000 customers, mainly small to medium sized enterprises.

2.3 Limerick County Council Development Control Policy

The Planning authority recognises that Limerick has potential for the development of renewable energy particularly from wind and water but that some areas of greatest potential occur in scenic areas. The Authority requires that any such developments be environmentally acceptable and apply a number of siting requirements restricting development in Natural Heritage Areas, Special Areas of Conservation, Special Protection areas, areas of archaeological potential, areas in proximity to National Monuments, and areas in which views and prospects are listed. Evidence of consideration of alternative sites may also be required. Pre-planning application discussions, co-operation with the concerned agencies and local community participation are also encouraged.

3 DESCRIPTION OF THE PROPOSED DEVELOPMENT

3.1 The Site

The site for the proposed wind farm is located on the south-eastern slope of Barnagh Hill at an elevation of 230-280mOD. It occupies an area of approximately 184ha. The land at the site is made up mainly of upland damp meadows, pasture areas and improved grassland. It is owned by 6 local landowners.

The site is accessed from the south via the a third class road (Lots Road) off the R515 and from the north either via an intersection with the N21 approximately 3km to the west of Templeglentan or from a minor road in the village of Templeglentan. Thirteen turbines will be located to the east of Lots Road. The remaining four will be located to the west.

The proposed wind farm does not lie within a proposed Natural Heritage Area (pNHA), Special Area of Conservation (SAC), area of archaeological, recreational or scenic importance.

3.2 Description of the Development

The development will comprise the installation of 17 turbines, with a maximum hub height of 65m. These turbines would have an installed generating capacity of 26 MW. A substation and internal site tracks, together with a grid connection to the ESB substation at Trien approximately 15km to the west will also be constructed. The grid connection will be the subject of a separate planning application. A 50m meteorological monitoring mast of lattice type construction will also be erected.

The proposed turbine layout is a trade-off between the need to maximise the energy output from the wind farm, site the turbines over the allocated landowner area and the necessity to minimise landscape visual impacts and more localised effects on nearby residences.

3.3 Construction Phase

The construction phase of the project will be carried out over a period of approximately 6 months. It will involve a number of activities, namely:-

- upgrading the site access roads, the extent of which will be agreed with Limerick County Council;
- construction of turbine access tracks and site drainage;
- construction of bases for the turbines and erection of the towers/turbines;
- construction of the site sub-station; and
- installation of electrical works, including underground cables.

3.4 Operational Phase

The turbines have a design life of at least 20 years. Once the facility is fully operational, no significant additional activities other than maintenance of the towers and turbines will take place.

3.5 Decommissioning

Although the turbines have a design life of at least 20 years, it may in fact be longer. Towards the end of this period, the developer will make a decision whether to replace or refurbish the turbines or to decommission the wind farm as a whole. This decision will be made on economic and technical grounds, which cannot be forecasted so far in advance. Decommissioning will involve the removal of the towers/turbines. The concrete bases and any access roads no longer required could be covered in an appropriate depth of soil and then re-vegetated. Where necessary, additional land reclamation works can be undertaken. In all cases, restoration works will be carried out to the satisfaction of the planning authority - Limerick County Council - and other interested bodies.

3.6 The Need for the Proposed Development

It is becoming increasingly recognised that large-scale wind farms in appropriate locations provide significant economies of scale and greatly reduce the amount of new overhead cabling required.

The development would make an immediate contribution to the need to secure Ireland's energy sources for the future and contribute 26MW of installed capacity from wind energy to the national grid helping to achieving the target of 500MW of installed capacity by 2005. It would also help attain Ireland's legally binding emission targets.

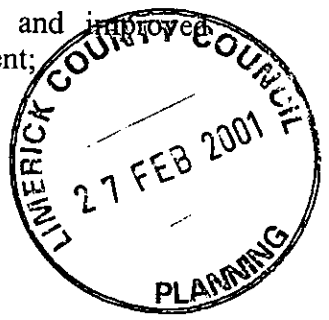
3.7 Site Selection and Alternatives Considered

Eirtricity Developments Ltd. have been prospecting for wind farm sites in Munster for the past 3-4 years. A list of alternative sites accessed in the West Limerick area is as follows:

- Reanaguillee, Toornafulla. This site was ruled out due to its distance from a suitable grid connection. With the land area available, the size of the site made the any development uneconomical;
- Sugar Hill. In respect of technical issue, this site was rated very highly. Due to its elevation, over 300mOD (the Toornafulla site is 230mOD to 280mOD), the wind speeds at this site would make this site more economical. However, due to its designation in the County Development Plan as an amenity area it was ruled out; and
- Knockfeerina, Ballingarry. This site was ruled out for two reasons, namely its distance from a suitable grid connection and because of the lack of natural landscape screening, the site would be highly visible.

The reasons for the selection of the Toornafulla site are as follows:

- economically viable wind speeds – mean annual wind speeds of 8.1m/sec have been recorded;
- suitable planning designation – the area is not designated scenic landscape in the County Development Plan;
- good site access – proximity to the N21 national primary road between Abbeyfeale and Newcastle West;
- natural screening by Sugar Hill to the north and the Mullaghareirk Mountains to the south;
- a worked landscape consisting of damp meadows, pasture and improved grassland, resulting in low sensitivity to the proposed development;
- proximity to high load electricity users in County Limerick; and
- proximity to a suitable grid connection.



4 LANDSCAPE - IMPACTS AND MITIGATION

4.1 Introduction

This section examines the potential effect of the development on the landscape. The relevant issues will be summarised below, with more information being presented in the main volume of the EIS. Sections 5, 6 and 7 consider other impacts of the development.

4.2 The Nature of the Landscape

The site lies on a southern-facing slope immediately to the east of Barnagh Hill. The vegetation consists mainly of upland damp meadows, pasture areas and improved grassland areas. The lands are used for pasture. A number of tributaries rise on the site and flow to the Allaghuan River in the valley to the south of the site.

The surrounding area consists of low-lying landscape to the east and west which gives rise to high visibility of the site in these directions. Areas of high elevation lie to the north and south of the site. The Mullaghereirk Mountains extend to within 2km of Barnagh Hill and are separated by the Allaghaun River valley. Sugar Hill lies to the north of the site and extends to the north of Newcastle West. It is separated from Barnagh at the Barnagh Gap approximately 3km to the north of the site.

The Mullaghareirk Mountains and Sugar Hill are listed view and prospect areas. Views at Barnagh Gap towards Newcastle West are also listed in the County Development Plan.

The character of the surrounding area is mostly made up of agriculture with some forestry plantations in areas of higher elevation particularly on the higher grounds around Sugar Hill and the Mullaghereirk Mountains.

The proposed site does not lie within a proposed Natural Heritage Area (pNHA) and it is not listed as a Special Area of Conservation (SAC).

The landscape character is best described overall as being predominantly man-made, with strong field patterns, a network of roads, including (the N21 national primary road) and (R515 regional road) to within 2km of the wind farm. The site also lies almost equidistant between Abbeyfeale and Newcastle West. These greatly diminish the sense of naturalness, which might otherwise occur in this landscape. The nearest telecommunications mast is located 2km to the north east.

4.3 Impact Methodology

The proposed wind farm will inevitably impact on the landscape and visual character of the surrounding areas and its perception will be subjective depending on one's opinion of renewable energy.

The main elements of the methodology employed were as follows:-

- a desk study and field work to describe the proposed development in the context of the site setting;
- the production and use of a zone of visual influence map to define the study area;
- the selection of viewpoints from where visual assessments were carried out;
- the compilation of a description of landscape character comprising landform, land use etc.;
- the production of photomontages depicting the proposed development;
- the description of likely impact; and
- recommendations for mitigation measures.

This process was greatly assisted by the use of a digital terrain model obtained from the Ordnance Survey of Ireland and by the use of a computer modelling programme, WIND FARM. This allowed the individual turbines to be accurately superimposed onto the photomontages.

4.4 Impacts on the Landscape as a Whole

To be commercially viable, wind farms must be located in exposed areas making them visible. This visibility is very subjective and wind farm can either be seen as a clean approach to energy generation or an unwelcome intrusion to the landscape.

A key aspect of the site selection and design was the screening that can be provided by the Mullaghareirk Mountains to the south and Sugar Hill to the north. There will be localised visual and landscape impacts. More long distance views are restricted.

The visual impact assessment involved the identification of all the key locations that might be affected by the development. These included all local towns and villages, scenic views/prospects, and regional and national roads and attractions.

The zone of visual influence map indicates that the visibility of the wind farm is highest along the southern slopes of Sugar Hill and along the northern slopes of Mullaghareirk Mountain. More distant views are seen from locations to the north-west and east of the site. This is demonstrated in Figure 4. Where the wind farm is visible, at least 13 of the 17 turbines, or at least part thereof, can be seen.

The N21 between Abbeyfeale and Newcastle West (the main tourist and commuter route in the area) is also impacted to the greatest extent outside Abbeyfeale and at Ballymurragh East.

In total, 6 viewpoints were selected for use in the visual impact assessment. These ranged from 1 to 6km to the nearest turbine. Individual photomontages were then constructed, which showed the turbines superimposed on the existing landscape. The landscape sensitivity was assessed and the visual exposure of the turbines determined. From this, an estimate of the visual impact was made. These are summarised in Table 4.1

Table 4.1 Estimated impact upon landscape from VPs

VP No.	Location	Summary Impact
1	Abbeyfeale	Moderate
2	Goulburn Bridge	Low
3	Templeglentan School	Low
4	Ballymurragh East	Moderate
5	Sugar Hill	Moderate
6	Toornafulla Church	High

In conclusion, the site proposed by Eirtricity Developments Ltd. is considered to be suitable for wind farm development in light of the low sensitivity of the landscape and its human-made character and the generally low to moderate visual impact.

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February 2001
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Discovery Series Sheet No. 64 and 72 (Survey 1996)
Figure 4 saved as view in this filefigure

13 -> 17 Turbines Visible

9 -> 12 Turbines Visible

5 -> 8 Turbines Visible

1 -> 4 Turbines Visible

The ZVI represents the worst case scenario in terms of viewing exposure.It is generated using digital terrain data at 10m contour intervals. It does not take account of local topographical features less than 10m in height or screening provided by hedgerows, buildings etc..

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1:60,000 ZONES OF VISUAL INFLUENCE (Hub Height 65m)
Showing View Point Locations

FIGURE 4

4.5 Proposed Mitigation Measures

Given their design and purpose, wind turbines will generally be visible from some location. It is an inescapable fact, therefore, that landscape impact will arise from wind farm development irrespective of turbine location.

In addition to the carefully selected location of the individual wind turbines, a number of general mitigation measures to reduce negative impacts further are set out in the EIS. These are summarised as follows:

- matt non-reflective finishes will be used on all turbine components;
- power lines between individual turbines and the substation will be placed underground;
- blades will rotate in the same direction on each turbine;
- the number and extent of new track roads will be kept to a minimum and properly landscaped immediately following completion of works; and
- the proposed development should not detract, in so far as is possible, from the enjoyment of amenities, both visual and physical, within or adjacent to the site; and a high standard of design will be applied to all structures associated with the substation.

5 HUMAN BEINGS - IMPACTS AND MITIGATION

5.1 Dwellings

Although the wind farm will impact dwellings to a lesser extent with increasing distance from the site, it is important to consider more localised effects on individual residences located in closer proximity to the development.

In total, there are 50 dwellings within 1km of the nearest turbines. Eighteen of these are situated within 500m of the nearest turbine. The closest occupied dwelling is 361m.

A significant component of the design of the wind farm was to have regard to adverse affects on dwellings in the immediate locality. Hence, the exact location of individual towers was determined by such considerations wherever possible.

Besides visual impacts upon individual properties, the development may have other effects, such as noise, shadow flicker, traffic and electromagnetic interference. These matters are considered separately below.

5.2 Noise

Noise monitoring was carried out around the site to determine baseline levels. The results typified a rural environment, with the main natural sources of noise being wildlife, dogs barking and farmyard sounds. The impact of human activities on noise levels in the existing environment was also prominent, including traffic, household appliances, machinery and general activities. Nighttime noise levels were considerably lower due mainly to the cessation and scaling down of human activities in the area.

During the construction period of the wind farm, the principal sources of noise will be excavation machinery and construction traffic. Impacts from noise emissions associated with the construction phase will be low/moderate and of short duration. In this respect, it has been noted that there is no dwelling closer than 361m from any proposed turbine location.

During the operational period, the principal source of noise will be the movement of the blades through the air. The large rotor diameters proposed for the wind farm have low rotational speeds which significantly limits noise emissions. The Lagerway turbine selected for this development is one of the quietest wind turbines available.

Modelling the worse-case-scenario (which does not take into account screening factors) shows that the increase in noise levels during the operational phase will not exceed the sleep disturbance criteria guideline of 43dB(A). Noise increases from the turbines caused by heightened wind speeds will also be offset by increases in background noise from other wind effects. The increase above baseline levels is significant. The increase is exaggerated however because of the low wind speeds (1 to 2 m/sec) present at the time of monitoring and the referenced wind speed of 8m/sec used to predict turbine noise emissions. At these low wind speeds (i.e. less than 4m/sec), the turbines will not be operational. At the higher wind speeds, say greater than 5m/sec, the background noise levels will drown-out the noise emissions from the turbines.

To mitigate against the potential impacts of noise on the local community, the following mitigation measures are proposed:-

- limiting the working hours at the site during the construction phase;
- controlling the movement of vehicles during off-peak hours;
- locating turbines away from dwellings as far as viably possible;
- using state-of-the-art wind turbines, which are specifically designed to minimise noise emissions; and
- ongoing monitoring of noise emissions after commissioning.

5.3 Electromagnetic Interference

The rotating blades of a wind turbine may cause interference to electro-magnetically propagated communication signals, such as satellite communications, RADAR, cellular radio communications, aircraft instrument landing systems, terrestrial microwave links and television broadcasts. However, the rural location of the wind farm means that the most significant impact, which may need mitigation, is possible interference with some television broadcasts.

Electromagnetic interference can have three forms:-

- interference from electromagnetic waves generated in the electrical equipment located in the nacelle of the turbine;
- signal scattering; and
- signal obstruction.

All these effects have the potential to reduce the enjoyment of recipients of the signals, which are subject to interference.

Communication with operators in the area (e.g. RTE) is ongoing to determine the potential for interference. The results of discussion with these operators will be forwarded to Limerick County Council. The communication masts in the vicinity of the site are located just south of Barnagh Gap and to the north of Sugar Hill. These are located 2km and 8km, respectively, to the north of the site.

At present it is difficult to predict accurately the effect of the wind farm on television reception. Such an assessment would involve a range of variables, which are difficult to model with any accuracy, particularly without the wind farm being in position. As a worst case scenario, it is expected that the houses in the immediate vicinity of the turbines will require some remedial measures. In practice, this would involve measures such as antenna relocation, relaying signals around or through the site and/or cabling signals under the site. Any remedial measures required will be undertaken by and at the expense of the developer.

5.4 Shadow Flicker

In conjunction with direct sunshine in the early morning and late evenings, wind turbines can produce a flickering effect on residents living in close proximity. This is caused by the rotor blades chopping the sunlight. For shadow flicker to occur a number of conditions must coincide. Sunny conditions most occur, with the sun aligning with the turbine and affected dwelling. In addition, the prevailing wind direction must be directly parallel to the sun's rays in order to place the blades perpendicular to the direction of the sunlight.

The significance of the effects are also a function of the distance of the dwelling from the wind farm. At a distance of greater than 8 rotor diameters shadow flicker will have little effect. It is also highly dependent upon suitable weather conditions coinciding with sun alignment.

Modelling indicates that 35 of the 50 houses within 1km of the nearest turbines may be impacted by shadow flicker. Of these, 19 are located within 560m of any turbine (i.e. 8 rotor diameters).

However these results represent a worse case scenario and the total number of hours over which shadow flicker can occur is spread out over a large number of days. Again, the model assumes that all the conditions necessary for shadow flicker will occur together.

5.5 Land Use

The Toornafulla site covers an area of 184ha approximately. It is used for non-intensive cattle grazing and pasture.

The land around the site contains a number of housing clusters and farmsteads along the R515 and county roads around the site. The nearest centres of population to the site are at Toornafulla and Templeglentan, approximately 2km from the site. The larger towns of Abbeyfeale and Newcastle West are located at a distance of over 7km.

With the exception of the larger towns, the land use in the greater area is predominated by agriculture including dairy and tillage. Coniferous forestry dominates land use on the higher ground in the general area.

Toornafulla is not a major tourist area relative to other regions in County Limerick. The site has not been identified in the Limerick County Development Plan as an area of visual or scenic importance. Neither is it an area of scientific or recreational importance.

With respect to the tourism potential of the area, it has not been established that wind farms would deter tourists. Indeed, it may be that the close proximity of the wind farm to Newcastle West may encourage day visitors specifically to view the wind farm in operation. The wind farm could also be regarded as having educational value, illustrating the mechanism of electricity generation and environment benefits associated with this renewable energy resource.

5.6 Traffic

The site is located along a third class road, which connects the R515 to the south and the N21 to the north. A network of other roads are also located around the site. The main traffic impacts will occur during the construction phase. It is estimated that 140 oversized HGVs will be required to transport the turbines to the site during the course of construction. Addition HGVs will be required to transport other construction materials. This will be spread out over the construction phase estimated at 6 months.

There will also trips by workers and on-lookers to the facility.

Once commissioned, the only employees accessing the facility will be site operations staff, with occasional visits from maintenance workers. The impact of this on local traffic will be negligible.

To mitigate against the potential impacts of traffic associated with the project, the following measures are proposed:-

- provision of traffic control while transporting oversized loads to the site;
- improvement and upgrading of local roads in consultation with Limerick County Council;
- movement of loads during off-peak hours;
- provision of on-site parking facilities for construction traffic; and
- sourcing material on-site for track and hardstanding construction.

5.7 Cultural Heritage

A desk based archaeological assessment was undertaken in order to identify any archaeological constraints associated with the proposed development. The Duchas Archaeological Sites and Monuments Database and the 1999 Limerick County Development Plan were consulted to determine the locations of the nearest archaeological features.

There are only two recorded monuments or archaeological features within 1km of the site boundary. There are no recorded monuments within the land bank available for development. The development will not have any negative impacts on the recorded archaeological features in the study area.

However, the ground disturbance associated with the construction of the wind farm may have an impact on unrecorded/buried sites, if present. A licensed archaeologist will therefore be employed to monitor ground disturbance. Any site discovered during construction will be fully excavated.

5.8 Other Socio-Economic Impacts

The design, construction and operation of the wind farm will provide employment to the local community as detailed in Section 1.5 – Local Economy. This will have a direct positive impact on the local economy. Rental income will provide an additional sustainable income to 6 local landowners.

Eirtricity Developments Ltd. has given an undertaking to make an annual contribution of 1% of its gross earnings to be divided between the parishes of Toornafulla and Templeglentan. This is estimated at £25,000/annum for the size of project proposed. There will also be a substantial rates income for Limerick County Council.

6 ENVIRONMENTAL ASPECTS – IMPACTS AND MITIGATION

6.1 Ecology

An ecology survey was conducted to survey the flora on site, identify the different habitat types present on site and to assess the suitability and impact of the proposed development on the ecology of the site and surrounding areas.

6.2 Flora

The only impact on flora will be as a result of land take for the development and this will be minimal. This will include 17 areas of hardstanding surrounding the turbines and substation and the tracks through the site. The remainder of the site will remain undisturbed.

Mitigation measures proposed are as follows:-

- the majority of the pastureland habitat on the site is to be left intact and undisturbed;
- construction activities will be managed so that off-track vehicle use will be avoided thereby minimising disturbance; and
- on decommissioning of the wind farm, the site will be restored to pastureland.

6.3 Mammals

An assessment was carried out to determine the existing habitat value to mammals, the occurrence of mammal species and the likely impact on mammal populations. In general, the site is considered to be of low to moderate importance for mammal populations.

It is not expected that the development will have a significant impact on mammals. It is possible that during construction, with increased activity on the site, mammals may be temporarily diverted from using the site. However, most small mammals are nocturnal and so would not be significantly affected by daytime activities.

It is unlikely that the development will have a significant impact on the travel path of small mammals using the site.

Apart from the areas of hardstanding on the site (around the turbines, site roads and substation) the habitat/vegetation of the site will not be changed. Most of the foraging areas utilised by small mammals will therefore remain intact. The site can continue to be used for agricultural purposes. No mitigation measures are therefore required.

6.4 Fauna – Birds

The numbers and diversity of birds recorded at the site were probably rather lower than would be expected due to adverse weather conditions time of year.

However, the open areas of this site probably hold a breeding bird community typical of such habitats, with Meadow Pipit, Skylark and probably smaller numbers of Snipe breeding. The ditches, hedges and shelter-belts probably hold small numbers of common songbirds such as Wren, Robin, Stonechat, Blackbird, Chaffinch and Reed Bunting. It is unlikely that any species of conservation value breed on, or close to, the site. Although published data indicates that Hen Harriers are present in the Mullaghareirks during the breeding season, there is no suitable breeding habitat on or close to the survey site.

Outside the breeding season, the site provides suitable feeding habitat for high densities of species, which utilise such open grassland habitats such as Golden Plover, Fieldfare and Redwing. The presence of these may attract birds of prey such as Peregrine and Hen Harrier to the area. This said, the habitats present are typical of large areas of Ireland and are hence not of major conservation value.

There are two potential types of impact to be considered:-

- Disturbance, and habitat damage or loss – during the construction/installation phase, during site maintenance visits, and ongoing aural/visual disturbance of the structures themselves; and

- Collision – collision with turbines or associated structures (including any of the aboveground power lines leading away from the site).

Disturbance, habitat loss and habitat damage may be a more important potential impact on birds than actual collisions at sites such as this. The most serious potential impact is on scarce species breeding at or near the site. Evidence of long-term impacts is however not well understood and further work is needed on a national scale.

Studies at other wind farms suggest that wind turbines have minimal impact on birds in terms of collision mortality. Taking account of the location and nature of the proposed wind farm, and the available information on avian usage of the site, no serious negative impact on birds is considered likely.

Mitigation measures proposed are as follows:-

- scheduling construction to avoid the more sensitive habitats during the breeding season;
- existing tracks will be used or improved where possible to reduce habitat damage, although at this site the opportunity for this is limited;
- site maintenance visits will be kept as brief as possible; and
- continued monitoring of avian usage of the site will be carried out, during and after installation.

6.5 Geology and Hydrogeology

The bed rock geology of the area consists of a number of Upper Carboniferous aged formations. These formations are made up of shale, muddy limestones and sandstones. Overburden material consists of glacial tills, which is generally thin over higher ground, but deeper in the valleys. These formations form either unproductive or locally important aquifers, depending of the percentage of shale present. The cleaner limestones are generally more productive.

Soil and rock will be cleared to construct site roads, hardstanding and foundations for the towers. Excavated material will be re-used on site and soil and rock excavation will be limited to the areas needed to complete the project.

There will be no impact on hydrogeology or groundwater use in the area. Fuel will be stored on site for plant machinery during the construction phase.

In order to prevent spillage or leaks, any diesel used on site will be stored in a suitable tank (steel/plastic) of good integrity. The storage tank will be bunded to 110% of the tank capacity and any leaks or spills will therefore be contained. The diesel storage tanks will be removed once construction has finished.

6.6 Hydrology

The main surface water body in the area is the Allaghaun River, which flows from east to west in a valley to the south of the site. The Allaghaun River is a tributary of the River Feale. Their confluence is just north of Abbeyfeale. A number of streams rise in the site and flow southwards. They merge together within a few hundred metres prior to joining the Allaghaun River approximately 1km to the south of the site. The Allaghaun River is classified as unpolluted for its entire length except for where it passes Abbeyfeale. At this location it is classed as seriously polluted for a short length.

The main hydrological impacts of the development are as follows:-

- increased suspended solids in surface water run-off;
- potential release of diesel or liquid concrete to the surface water; and
- increased run-off from the site due to site road and turbine foundation construction.

To mitigate against these potential impacts, the following measures will be implemented:-

- silt traps will be constructed as necessary to reduce suspended solids in the surface water run-off during construction,;
- best practice in managing surface water will be employed during the construction phase;
- diesel stored at the site will be in a bunded, steel or plastic tank of sound integrity; and
- drainage channels will be placed along the road edge and on the upslope side of the hardstanding areas to control the increased surface water run-off.

6.7 Climate

The long-term weather patterns at the site reflect regional conditions affecting the Munster area, dominated by low fronts from the west and south-west in winter months and more settled conditions during the summer months. The average annual precipitation of the area is 1,128mm as recorded at Abbeyfeale rain recording station. The mean annual wind speed for the site is approximately 8m/sec.

The development of the wind farm will have a positive impact on the climate. The generation of 'green' electricity will result in the avoidance of greenhouse gas emissions that would otherwise occur from fossil fuel power generating plants. For example, the generation of electricity at the proposed wind farm site, compared with a coal fired power station of similar capacity, would result in reductions of CO_2 emissions of 72,500 tonnes per year, with associated reductions of SO_2 and NO_x by 850 tonnes and 250 tonnes respectively. Hence, the wind farm would prevent emissions of 1.4 million tonnes of carbon dioxide over its twenty year design life. No mitigation measures are therefore required in relation to climatic impacts.

7 CONCLUSION - MATERIAL ASSETS AND THE INTERACTION OF IMPACTS

Wind energy is a clean, renewable and sustainable means of electricity generation. It is one of the most cost-effective energy options for reducing global warming and does not result in the creation of any dangerous waste products.

The development of the Toornafulla wind farm will have positive and negative impacts upon the material assets of the receiving environment.

7.1 Positive Impacts

Besides reducing harmful atmospheric emissions, wind energy is an indigenous, secure and sustainable resource – unlike energy derived from fossil fuels. While new sources of fossil fuels are being continually discovered, these resources are inevitably finite and will be depleted over time. The development of wind energy slows down this rate of depletion and offers an alternative local power source. Wind power, therefore, has a significant potential contribution to the security and diversity of national energy supply in Ireland.

The wind farm development will make more effective use of land presently used for non-intensive grazing. The local climatic conditions are very suitable for such development, this area being open and windy. The wind resource can be considered a material asset of County Limerick, which will now be utilised. Most of the site can continue to be utilised for grazing while the wind farm is in operation.

The development of wind energy projects in rural areas provides an increased sustainable income for landowners, as the utilisation of their land can be diversified.

The developer has given an undertaking to contribute 1% of gross earnings from the wind farm to the communities of Toornafulla and Templeglentan, estimated at £25,000/annum.

7.2 Negative Impacts

While wind turbines may be considered an environmentally benign technology for energy generation, they may be perceived as an unwelcome intrusion on the landscape. Inevitably, the overall character of the landscape will be changed by the development, as some locations will be subject to visual impacts.

There are a significant number of residences in close proximity to the site, many of which will suffer impacts. The most difficult to mitigate are visual impacts. Other impacts can be more readily remedied. These are noise, shadow flicker, potential disruption to TV reception.

To date there has been no evidence to suggest that tourism in an area may be negatively affected by the presence of a wind energy facility.

7.3 Interaction between Different Environmental Aspects.

An inevitable aspect of a large scale wind farm project is the interaction between a number of environmental factors and issues. Some of these will be negative, while others offer an opportunity for positive environmental benefits to accrue from the development. An example of the former type of negative impact is the inevitable change in the visual appearance and character of the affected part of the landscape. These and other costs must be weighed against the benefits expected to accrue from this project, such as the large quantity of electricity which can be generated from a clean sustainable renewable energy source and the associated avoided emissions of carbon dioxide.

The nature of the environmental and economic costs and benefits have been summarised in this Non-Tcchnical Summary. They are fully considered in the main report of the EIS for the Toornafulla Wind Farm project. Taking into account all of the impacts of the development and the interaction between differing environmental factors, it is concluded that the development will not have an overall significant negative effect on the environment as a whole but will have negative impacts on the nearest residences to the site. In many cases where negative impacts have been identified, mitigation measures are readily available to address them.

This development represents an explicit commitment to the process of developing sustainable energy sources in Ireland. It thereby furthers national and international policy on both greenhouse gas abatement and on the development of renewable energy sources.


LIMERICK COUNTY COUNCIL
27 FEB 2001
PLANNING

ENVIRONMENTAL IMPACT STATEMENT

FOR

A PROPOSED WIND FARM

AT

AT TOORNAFULLA, CO. LIMERICK

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February 2001

ENVIRONMENTAL IMPACT STATEMENT

FOR

A PROPOSED WIND FARM

AT

AT TOORNAFULLA, CO. LIMERICK

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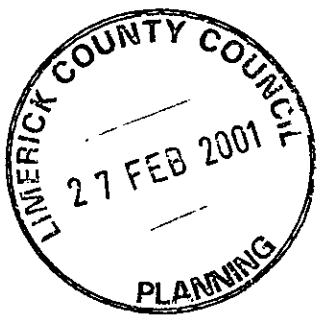

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PREAMBLE

In accordance with recent Government policy to increase the renewable energy electricity generation capacity in Ireland by 500MW by 2005 (Green Paper on Sustainable Energy[1]) and our obligation under the Kyoto Protocol to limit greenhouse gas emissions, Eirtricity Developments Ltd. wishes to establish a 26MW wind energy facility near Toornafulla, Co. Limerick. Ireland has a huge potential energy source in wind power. Strong Atlantic frontal systems flowing across our lands provide us with enough wind power to potentially supply 19 times Ireland's electricity requirements.

Astute investment in and development of the wind energy resource in this country will result in an avoidance of greenhouse gas emissions and other pollutants associated with energy production using fossil fuels. It will provide security of energy supply, will reduce reliance on fuel imports and will lead to increased investment and employment in the economy.

Ireland currently depends largely on fossil fuels for its energy needs. While we have native fossil fuel energy sources such as natural gas and peat, they only represent around 8% of current energy use. Hydropower represents around 5% of current power generation capacity. Wind energy contributes approximately 2.7% to the nation's electricity generating capacity. Almost 85% of our energy comes from imported fossil fuels, a percentage that is predicted to increase to 94% by 2010 under a business as usual scenario, as our indigenous fossil fuel energy supplies deplete and energy demand increases.

The site, which is the subject of this Environmental Impact Statement (EIS), is located in the townlands of Templeglentan East, Killacullen and Glenmore West. The site was selected based on its suitability with regard to relatively high average wind speeds, proximity to a suitable grid connection and access to the site. The facility will include 17 wind turbines, site access roads, meteorological mast, substation and grid connection (which will be subject to a separate planning application).

The EIS is subdivided into a number of sections, namely: -

- a non-technical summary provided in Volume 1.
- volume 2, Section 1 is an introductory section, which presents the history of wind technology, economics and status of wind energy. It also introduces the benefits of this renewable energy source.
- volume 2, Section 2 is a description of the existing site and the proposed development.
- volume 2, Section 3 through 12 deal with the various elements of the existing environment, the potential effects of the proposed development and the relevant mitigation measures.
- the Appendices (Volume 3) contain additional technical back-up material.

The Environmental Impact Statement has been prepared by Fehily Timoney & Co. (FTC) on behalf of Eirtricity Developments Ltd. for submission to Limerick County Council in support of the Planning Application for this development.

1. INTRODUCTION

1.1. Introduction to Wind Energy

1.1.1. History of Wind Energy

The energy supply crises in the early 1970s, and the global realisation of the destructive impact of greenhouse gas emissions on the environment throughout the 1970s and 1980s created a substantial interest in the research and development of renewable energy technologies, in particular wind energy technologies.

The first large market for wind turbines appeared in California, USA in the early 1980s. The growth of this market stimulated the development of wind technology in many other countries including Denmark, UK, Germany, Japan and the Netherlands. By the early 1990s research and development had led to technological advances resulting in wind turbines becoming more cost effective and the second period of growth for the wind energy industry began.

1.1.2. Need for Renewable Energy

The burning of fossil fuels results in the release of greenhouse gases such as carbon dioxide (CO_2). Since the beginning of the industrial revolution, atmospheric concentrations of CO_2 have risen by 30%[2]. These gases contribute to the phenomenon known as global warming resulting in climate change. During the 20th century the average temperature of the earth rose by 0.5° C to its present 15°C. The scientific consensus is that the combustion of fossil fuels has contributed significantly to this increase.

In "*Ireland's Environment – a Millennium Report*,"[3] the Environmental Protection Agency (EPA) identifies climate change as one of the most serious environmental problems facing Ireland at the present time. It states that "European governments accept that climate change is the gravest threat to the world's sustainable development, public health, and future prosperity, and that it requires immediate counter-measures."

International, national and local policies have been adapted to meet the challenges arising from climate change. In the past ten years a number of international conferences have been held in relation to these issues namely Rio (1992) and Kyoto (1997).

Rio Conference (1992)

At the 1992 United Nations Conference on the Environment and Development held in Rio de Janeiro, 154 counties signed a UN climate convention. These countries agreed to adopt measures to reduce greenhouse gas emissions (particularly carbon dioxide).

Kyoto Protocol (1997)[4]

The Kyoto Protocol (1997) was born out of the United Nations Framework Convention on Climate Change, 1992 (UNFCCC). Legally binding targets were set for greenhouse gas emission reductions for developed countries for the period 2008 – 2012[5]. Nations who signed up to the protocol agreed to take actions to control, reduce or limit their emissions of the six main greenhouse gases.

The EU has agreed to reduce its emissions of greenhouse gases by 8% below 1990 levels by the period 2008 – 2012. The six greenhouse gases are carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride.

Within this limit, Ireland has agreed to limit the increase in emissions of these gases to 13% above 1990 levels by the same period (see Table 1.1). There are likely to be substantial financial penalties for failure to meet the targets.

Table 1.1 Targets for Reductions in Greenhouse Gas Emissions under the Kyoto Protocol (1997)

Geographical Area	Target by 2012
All developed countries	Reduce emissions to 5% below 1990 levels
EU	8% reduction below 1990 levels
Ireland	Maximum increase of 13% above 1990 levels

In a report published by the EPA in August 2000, "*Emissions to Air – 1990 to 1998*,"[6] it is stated that Ireland's emissions were already higher in 1998 than the limits agreed for 2010 under the Kyoto Protocol. The EPA stated that the major contributory factor in this increase was a 30% increase in carbon dioxide emissions since 1990.

Recent forecasts from the Department of the Environment and Local Government estimate that net emissions in the period 2008 – 2010 will have increased by 37.3%[7] based on a business as usual scenario, which is approximately three times the target agreed at Kyoto

Against this backdrop, there is clearly a need to source renewable sources of energy if we are to sustain current rates of economic development. Wind energy affords the opportunity to provide a sustainable and economically viable method of helping to meet the Earth's energy needs while also meeting the Kyoto targets.

The Department of the Environment and Local Government has published the National Climate Change Strategy (November 2000). This sets out a framework for meeting the Kyoto target. This paper highlights the potential for the use of wind energy to meet our greenhouse gas emission targets. *"The maximisation of renewable capacity is essential towards meeting our Kyoto Protocol target, and progress in attaining the targets for the increase in renewable capacity will be an important aspect of the biennial review of this Strategy"*. The introduction of carbon/energy taxes and the emissions trading system will increase the competitiveness of renewable energy.

The strategy also outlines a new focus for local authorities whereby they can make a contribution towards raising awareness and initiating climate change action in local communities. Local authorities also play a role in relation to greenhouse gas reductions in a number of sectors, including planning.

1.1.3. European Position

Europe currently relies on imports to meet 50% of its energy requirements. Of the remaining 50% of its total energy requirements, less than 6% is from renewable energy sources[8]. At the end of 1999, Europe had 8,375MW installed capacity of grid connected wind power plants with an annual electricity production of 16.5TWh. The European Commission's White Paper *"Energy for the Future: Renewable Sources of Energy"* sets out a strategy to obtain 12% of energy in the EU from renewable sources by 2010. In the White Paper this 12% share of total renewable energy in the gross energy consumption is equivalent to 22.1% of electricity consumption.

Campaign for Take-Off[9] is the EU's Action Plan for the implementation of the White Paper. It sets a target for the development of 10,000MW of large wind farms by 2010 and furthermore, sees this as being only 25% of the feasible wind energy development by that time.

It is not considered that any "public financing will be needed for the 30,000MW remaining installed capacity providing that a fair access to the European grids for the wind turbines is guaranteed...an additional help is needed only for the less favourable or unconventional applications...".

Finally, the proposed EU Directive on Renewable Energy Electricity[10] has as strategic objectives:

- the creation of a framework for the significant increase of renewable energy generated electricity in the EU and to facilitate its access to the internal electricity market in the medium term; and
- the promotion of electricity from renewable sources as a high Community priority.

The proposed Directive suggests an indicative target of doubling the share of renewable energy sources from 6% to 12% in the energy balance in the EU by 2010. The European Council endorsed this objective in 1998. The increased use of electricity from renewable sources would also constitute an important part of the actions that will be necessary to meet the commitments to reduce greenhouse gas emissions made by the EU in Kyoto.

The proposal obliges Member States to establish individual targets for future production of electricity from renewable energy sources (RES-E). To encourage the development of renewable energy projects, EU funding is available through a number of schemes (e.g., EU 5th Framework Programme for Research and Development, *Energie* sub-programme).

1.1.4. Status of the Industry in Ireland

The Irish economy is expanding rapidly, and already the ESB is under pressure to meet existing power demands. The installed capacity in Ireland is at present approximately 4,577MW[11] (i.e., fossil fuel powered generating stations and renewable). Demand for electricity is expected to increase by 65% by 2010 compared to 1998 levels[12] (i.e. approximately 5% per annum). Currently approximately 2% of Ireland's total energy requirements (7.4% of installed electricity generating capacity) are met using renewable resources. The majority of this energy comes from hydroelectric schemes, with wind energy contributing approximately 2.7% to the total electricity generating capacity (see Table 1.2). At the end of 1999, the installed capacity of wind energy in Ireland was 70MW from 11 wind farms. In 2000, 11 additional wind farms were installed and commissioned bringing the total installed capacity for wind generation to approximately 125MW.

Table 1.2 Renewable Energy Installed Capacity in Ireland

Technology	Installed Capacity (MW)	As a Percentage of Ireland's Electricity Generating Capacity
Large Hydro	200	4.4%
Small Hydro	32	0.7%
Wind	125	2.7%
Landfill Gas	15	0.3%
Total	372	7.4%

With one of the best wind regimes in Europe (see Figure 1.1), Ireland has the potential to supply 19 times its electricity requirements[13].

However, the amount of wind generated electricity that can actually be used is substantially less than this due to technical constraints. The ESB and IWEA have indicated that between 10% and 20% of the total electricity demand can be generated by wind. The reason for this is the intermittent nature of wind. When there is no wind there will still be an electricity demand; this will be supplied by existing power stations.

1.1.5. Irish Energy Policy

Irish energy policy is built upon strengthening security of supply, diversifying energy sources with a focus on indigenous greenhouse gas emission targets and increasing generating capacity to facilitate growth.

The 1999 Green Paper on Sustainable Energy set a target of 500MW renewable energy development by 2005, mainly expected to come from wind energy. The Renewable Energy Strategy Group was established as a result of the Green Paper, and has made a number of recommendations in its "*Strategy for Intensifying Wind Energy Deployment*"[14] to develop the industry. The strategy group feels that "*large scale wind farms should be encouraged to achieve efficient deployment of wind energy and to avoid a proliferation of grid connections*". The executive summary of this strategy document is provided in Appendix A.

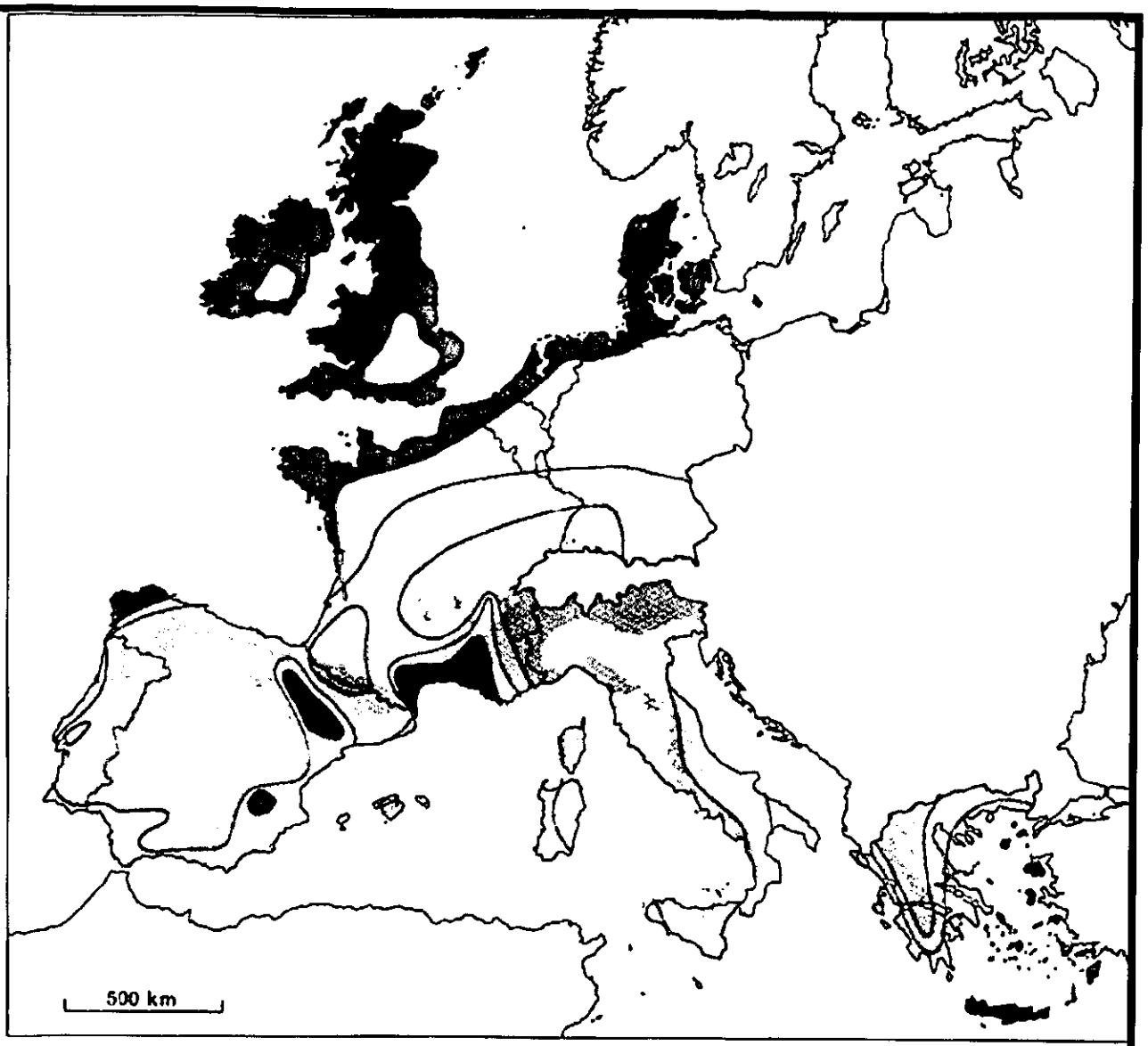
1.1.6. Market Access

Market Access has expanded with liberalisation of the electricity market in February 2000. The Electricity Regulation Act of 1999, provides that 28% of the market will be open to brown electricity suppliers, while green suppliers have access to the whole market.

Provision in the legislation imposes public service obligations on licence holders in relation to environmental protection. This will further encourage the development of Ireland's renewable energy resources.

Since February 2000, Eirtricity has attracted over 6,000 customers, mainly small to medium sized enterprises.

Illustration: European Wind Energy Association



Wind speed at 50 metres above ground level for four different topographical conditions (metres per second)

Colour on map	Open plain	At sea coasts	Open sea	Hills and ridges
	>7.5	>8.5	>9.0	>11.5
	6.5 – 7.5	7.0 – 8.5	8.0 – 9.0	10.0 – 11.5
	5.5 – 6.5	6.0 – 7.0	7.0 – 8.0	8.5 – 10.0
	4.5 – 5.5	5.0 – 6.0	5.5 – 7.0	7.0 – 8.5
	<4.5	<5.0	<5.5	<7.0

Fehily Timoney & Company

WIND SPEED GRAPH

FIGURE 1.1

1.1.7. Benefits and Costs of Wind Energy

Benefits of Wind Energy Development

The benefits of wind energy include the following; -

- reduction in the level of greenhouse gases emitted to the atmosphere and contribution towards attainment of Kyoto targets;
- abatement of other pollutants and environmental protection;
- reduction in energy importation, use of an indigenous resource, security of energy supply, and improvement in the balance of payments;
- local economic benefits (see Section 3.2.4);
- contribution to sustainable development; and
- local embedded generation.

Costs of Wind Energy Development

The costs associated with wind energy include both economic and environmental costs:-

- *Economic Cost*
  The cost of wind energy is determined by factors such as the wind speed at the site, wind turbine availability (due to maintenance, etc.), siting of the turbines, and the cost and structure of finance. The cost of generating electricity from the wind is made up primarily of the capital cost, with annual operational costs generally being between 2% and 2.5% of capital investment; and
- *Environmental Cost*
  The environmental costs include land take, habitat loss, noise and visual impacts. These will all be discussed in detail in the following chapters. Generation of electricity from the wind, unlike other energy technologies, involves negligible pollutant emissions to the air (during the construction phase) and no emissions to land or water.

1.1.8. Public Attitudes

Numerous surveys on public attitudes towards clean and renewable energy generation have been carried out throughout the world.

In the USA and Europe, public support has strengthened for cleaner and "greener," energy production, as awareness grows about the causes of environmental damage and climate change. On the whole, the public is very much in favour of the development of renewable energy, in combination with increased energy efficiency, to meet energy needs.

In a UK research summary of independent studies it has been demonstrated that the overwhelming majority of residents in areas with a wind project are pro-wind power, both in theory, as a renewable energy source and in practice in their areas. An average of 8 out of 10 people supported their local wind farm[15]. Other surveys had similar results including surveys in Wales[16], the Netherlands[17] [18], Sweden[19] and North America[20] [21].

In Ireland, the Irish Wind Energy Association (IWEA) commissioned a survey by Drury Research, published in 1999[22]. The survey found that:

- 67% of respondents agreed that the Government should support the development of wind energy in Ireland;
- 93% of those who are aware of wind energy support its development;
- wind power attracted the highest mean score when the respondents were asked to rank forms of energy in terms of their environmental friendliness;
- wind, solar power, hydro and wave power rank highest in terms of their perceived environmental friendliness; and
- perceived disadvantages of wind power were much more likely to centre on its ability to provide a continuous power supply, rather than any perceived visual intrusion.

1.2. Development Policy

There are a number of guidance documents, plans and strategy documents concerning wind farm developments. These include the Limerick County Development Plan, Local Agenda 21, Department of Environment Wind Farm Development - Guidelines for Planning Authorities, the Strategy for Intensification of Wind Energy Deployment, and Climate Change Strategy.

1.2.1. Limerick County Development Plan (1999)

The Limerick County Development Plan addresses the subject of renewable energy in Section 12. Overall there is pre-disposition in favour of renewable energy development, however there is an onus on developers to demonstrate the suitability of a given site.

"The Planning Authority recognises that Limerick has potential for the development of renewable energy particularly from wind and water. However some of the areas of greatest potential coincide with areas of scenic importance in the county".

The County Development Plan contains a list of policy statements in relation to the development of renewable resources.

- *"the Planning Authority will adopt a positive approach to renewable energy developments provided they are environmentally acceptable.*
- *the Planning Authority will however restrict the number and size of developments particularly in sensitive locations such as Natural Heritage Areas (NHAs), Special Areas of Conservation (SACs), areas of archaeological potential, areas in proximity to National Monuments, Special Protection Areas (SPAs) and areas where views and prospects are listed, unless it can be demonstrated that these developments will not have a serious impact on these designated areas.*
- *pre-planning application discussion with potential developers is encouraged while also emphasising the need for local community participation.*
- *evidence of consideration of a number of alternative sites for potential development may be required to be submitted to the Planning Authority.*
- *prohibit inappropriate developments such as large-scale forestry developments adjacent to renewable/alternative energy projects, which would inhibit their efficient operations.*
- *in some cases temporary permissions only will be granted for developments to enable the Planning Authority to further assess the impact of the development on its surrounding environment.*
- *co-operate with concerned agencies at pre-planning application and application stages.*
- *assess the cumulative impact of developments on an area".*

Development guidelines from the County Development Plan on renewable energy projects (including wind energy) are presented in Appendix B of this report. It is considered that the proposed wind farm will comply with these guidelines.

The elements of the County Development Plan that have a bearing on the development of a wind farm are as follows:

- the location of the site relative to tourist/recreational areas;
- the location of the site relative to views and prospects;
- the location of the site relative to tourist routes;
- the location of the site relative to designated areas (NHAs, SPAs, SACs), national monuments and listed buildings; and
- location of the site relative to dwellings.

These are discussed in detail through various aspects of this report.

1.2.2. Local Agenda 21

Agenda 21[23] is the UN Action Plan to achieve global sustainable development in the 21st century. It calls on local authorities worldwide to draw up Local Agenda 21's to promote sustainable development at local level. The Department of the Environment Guidelines on Local Agenda 21 state that "*local authorities have many opportunities for incorporating the aims of Local Agenda 21 into their policies and activities*"; and also that "*land use policy and controls are a critical means of ensuring sustainable development.*"

Ireland has one of the best wind regimes in Europe. Using this to generate electricity sustains development in a number of ways:

- assists maintaining population in agricultural areas, by adding a sustainable additional source of income;
- no emissions of greenhouse gases during operation;
- reduces dependence on imported fuels (e.g. oil, coal);
- contributes to balance of payments by reducing imports;

- the whole site can be restored to previous condition, if wind energy is decommissioned; and

- because land take is so small, previous agricultural activities can continue.

1.2.3. Other Relevant Policy and Strategy Documents

Local Authorities have been using the Department of Environment guidelines to assist in the consideration of planning applications for wind farms. These guidelines were published in 1996. Since that time a number of Government initiatives have taken place. These policy statements provide a completely new framework within which proposals for renewable energy projects can be assessed.

The recently published report on the "*Strategy for Intensifying Wind Energy Development,*" outlines a way forward for the wind energy industry. This document addresses such issues as grid connections, markets, development scale and planning issues. The strategy recognises the need for large-scale developments to meet government targets of 500MW of installed capacity by 2005.

The National Climate Change Strategy (Department of Environment & Local Government, 2000) points out that "*the work of the Renewable Energy Strategy Group in its recently published report Strategy for Intensifying Wind Energy Deployment dealing with the electricity market, the electricity network and spatial planning will be critical in ensuring the expansion of wind energy projects*". Such developments will mean fewer grid connections.

1.3. Need for the Proposed Development

Wind energy technology satisfies each of the following provisions of current national energy requirements as follows: -

- strengthening security of supply;
- obtaining energy supplies from indigenous sources;
- Diversification of energy sources;
- Reduction of environmental damage due to electricity production from fossil fuels;

- Provision for increasing energy demand;
- Contributing to the objectives of the national CO_2 abatement strategy; and
- Contributing to the EU targets set out in the Altener programme.

The development of renewable energy is particularly identified in several referenced Government documents, as being one of the primary strategies in dealing with these issues.

With regard to the local development policy, the main impacts of the proposed project are socio-economic and environmental. A significant amount of materials and services required over the construction period will be sourced in the local area. The proposed wind farm will make an annual contribution of 1% of its gross earnings to be divided proportionally between the parishes of Toornafulla and Templeglentan, estimated at £25,000/annum. This will result in significant long-term economic benefits for the local community.

Environmentally, the project will avoid pollution loads and add significantly to local sustainable development goals, as required by Local Agenda 21. Ecologically, the wind farm is exceptionally benign.

1.4. Site Selection

Eirtricity has been prospecting for wind farm sites through out Ireland for the last [illegible] years. The site was selected based on a number of criteria.

1.4.1. Site Selection Criteria

Sites are selected using a sequential screening process. The primary criteria used in the screening process are as follows:

Proximity to National Grid: proximity to a suitable ESB distribution network reduces the length of grid interconnection lines, thus minimising the environmental impact. Also, the cost of transmission to the national electricity grid is such that unless the proposed site is at economic distance to, either a 38kV line, a 110kV line, or an ESB substation, the site would be too expensive to develop.

Wind Speed: having examined those areas close to the national grid, there must be wind speeds consistent with the economic development of a wind farm. Experience has shown that unless a site is at a high elevation, or near the coast at a lower elevation, it is unlikely that the appropriate wind speeds will be present.

Planning Designation: Sites matching the preceding criteria are then considered in light of planning designation. Areas designated as scenic (which very often coincide with the upland or coastal areas where high wind speeds are to be found) are not further considered.

Accessibility: Those sites that are inaccessible must be eliminated. If there are no existing access roads, and the terrain is very difficult, the cost of access roads may be excessive. In addition, in difficult terrain, the extent of excavation required for the construction of access roads could have a negative visual impact.

Land Availability: From the residual suitable locations, sites where other developers are investigating can be discounted. Of those remaining the agreement of landowners must then be sought.

Clearly, at this stage of choosing a site for development, many sites will have been assessed and disregarded.

1.4.2. Toornafulla Wind Farm Site

The Toornafulla wind farm site was chosen as a priority using the site screening process described above. The reasons for its selection are as follows;

- average wind speeds at the site are economical for a wind farm. Wind monitoring has been carried out over the part 2 years. Average wind speeds of 8.1m/sec have been recorded;
- the County Development Plan places no barriers to the proposed development in this area. The site is not designated as a pNHA or pSAC, nor is it contained in a area of scientific or scenic importance;
- access to the site is good. The proposed route of transport being along the N21 and the R515;

1.4.3. Alternative Sites

A number of other sites were investigated for their suitability for a wind farm development. However they failed in one or more of the selection criteria and were therefore eliminated. Of these sites, three are located in County Limerick.
These are:-

- Reanaguillee, Toornafulla. This site was ruled out due to its distance from a suitable grid connection. With the land area available, the size of the site made the any development uneconomical;

- Sugar Hill. In respect of technical issue, this site was rated very highly. Due to its elevation, over 300mOD (the Toornafulla site is 230mOD to 280mOD), the wind speeds at this site would make this site more economical. However, due to its designation in the County Development Plan as an amenity area it was ruled out; and

- Knockfeerina, Ballingarry. This site was ruled out for two reasons, namely its distance from a suitable grid connection and because of the lack of natural landscape screening, the site would be highly visible.

1.5. Pre-Submission Consultations

In the course of the preparation of EIS, a number of organisation and individuals were consulted. These are set out in Table 1.3. A copy of the information packages sent to these organisations is provided in Appendix C. The first was distributed in September 2000 and a second information package was sent following the finalisation of the site layout. No replies have been received to date. Any received subsequent to submission will be forwarded to the Council.

Table 1.3 List of Organisations Consulted

1.	An Taisce
2.	Office of Public Works
3.	Department of Agriculture, Food & Forestry
4.	Department of Arts Heritage, Gaeltacht & The Islands
5.	Geological Survey of Ireland
6.	Electricity Supply Board
7.	*Duchas* – The Heritage Service
8.	National Monuments Authority
9.	Department of the Environment and Local Government
10.	Department of the Marine & Natural Resources
11.	Department of Tourism, Sport & Recreation
12.	Department of Public Enterprise
13.	Radio Teilifis Eireann
14.	Birdwatch Ireland
15.	Irish Wildlife Trust
16.	Irish Aviation Authority
17.	Meteorological Services
18.	Irish Peatland Conservation Council
19.	Teagasc
20.	Bord Failte Eireann
21.	Irish Farmers Association
22.	Eircell
23.	Esat Digifone

In addition, Eirtricity and Fehily Timoney & Co. have consulted directly with the planning department of Limerick County Council during the preliminary stages. The transmission department of the ESB has also been consulted in relation to the grid connection. The developer has also held a public information exhibition at Toornafulla Community Hall on the 16th February, which was advertised locally (see Appendix D). Eirtricity and FTC personnel attended the exhibition. Aspects of the proposed wind energy project were presented. The meeting attracted local interest and in addition to the local and neighbouring parishioners, was attended by the local Gardai, politicians and journalists. One of the key outcomes was the interest in wind energy and many additional landowners expressed interest in diversifying their land use for wind farming. A number of residents expressed concern regarding visual impact, noise, shadow flicker and electromagnetic radiation. These topics are discussed in detail in this report.

1.6. Scope of EIS

The European Communities (Environmental Impact Assessment Amendment) Regulations, 1999[24] requires that an EIA is carried out for installations with more than 5 turbines or having a total output greater than 5MW.

The scope of the EIS is developed from the second schedule of the 1999 EIA regulations.

Contributors

The EIS was prepared by FTC, Core House, Pouladuff Road, Cork. Specialist consultants employed with reference to specific portions of the study were as follows:

- Aquatic Services Unit: Bird Survey

Format of the EIS

This document has been prepared in accordance with guidelines provided by the EPA included in: -

- Advice notes on Current Practice (in the preparation of Environmental Impact Statements)[25]; and
- Draft Guidelines on the Information to be Contained in Environmental Impact Statements[26].

The EIS has been prepared using the "Grouped Format Structure" as recommended in the *Draft Guidelines on the Information to be Contained in Environmental Impact Statements.*

Using the grouped format structure, an EIS is prepared in a format that examines each topic as a separate section referring to the existing environment, the proposed development, impacts and mitigation measures (i.e. ecology and the proposed development, ecology in the existing environment, impacts on ecology, mitigation measures for ecology, etc.).

The report is submitted in three volumes: -

Volume 1: Non-Technical Summary
Volume 2: Main Report
Volume 3: Appendices

The non-technical summary provides an overview of the work carried out and presented in the main body of the EIS. It is a shortened and simplified version of Volume 2 but contains all the relevant facts presented in a non-technical format.

2. DESCRIPTION OF THE PROPOSED DEVELOPMENT

2.1. Existing Site Setting

The proposed wind farm is located between Toornafulla, 2km to the south, and Templeglentan, 2km to the north of the site. A minor road (locally known as Lots Road), that connects the R515 and N21, bisects the site. Two thirds of the site lies to the east of Lots Road. The site location is shown on Figure 2.1.

The site covers an area of 184ha of agricultural land divided into a number of fields owned by six local landowners. The land is used predominately for pasture. Tributaries of the Allaghaun River rise on the site.

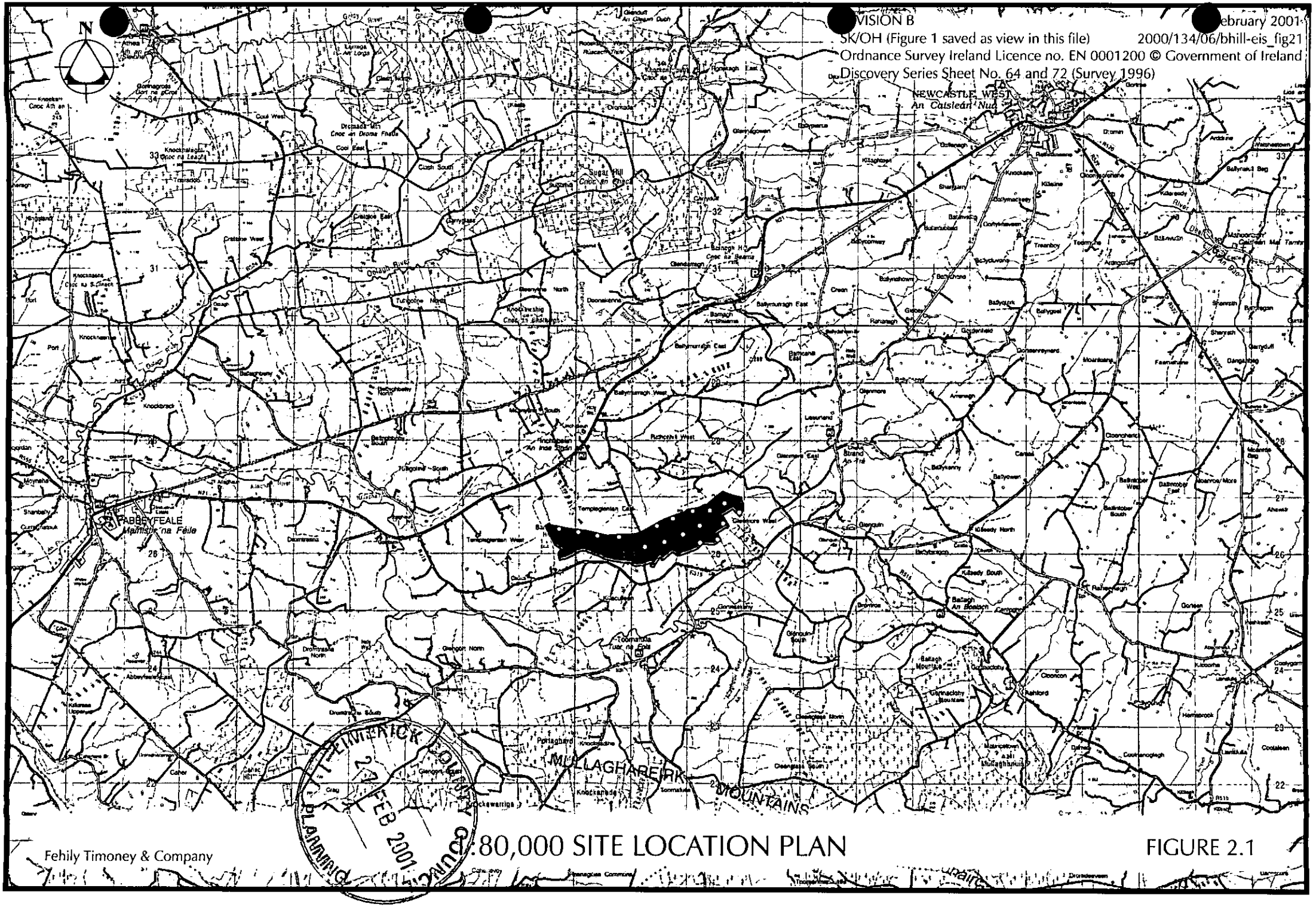
Barnagh Hill is located to the west of the site at an elevation of 272mOD. The site itself varies in elevation from 230mOD to 280mOD. Th Mullaghareirk Mountains lie 5 to 6km to the south of the site, reaching 390mOD. To the north lie the Sugar Hills, reaching 344mOD at Knochanimpuha.

The environmental aspects of the existing site and environs are provided in Sections 3 through 12 of this EIS.

2.2. Description of the Development

The development will comprise the installation of 17 turbines of hub height 65m and blade diameter 70m. Details are provided in Drawing No. 3. On-site assess tracks, cable trenches, drainage works will also be required. Other site infrastructure will include a meteorological mast and a 38kV electrical substation. Details are provided on Drawing No. 2.

Figure 2.2 (and Drawing No. 1) shows the proposed site layout. A grid connection to the 110kV substation at Trien, 15km to the west of the site, will also be constructed. This will be subject to a separate planning application by ESB.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1:80,000 SITE LOCATION PLAN
Fehily Timoney & Company
FIGURE 2.1

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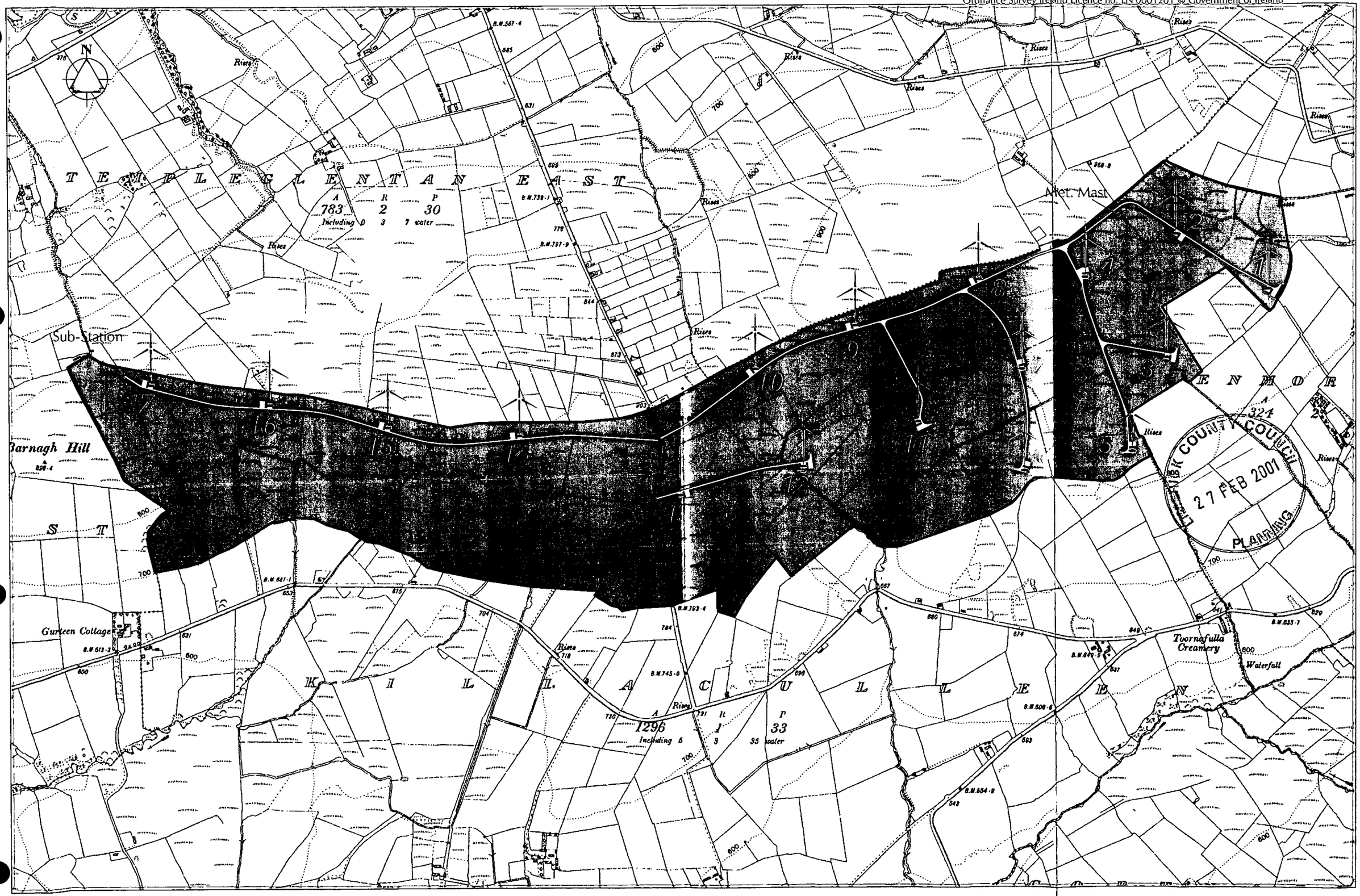

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1:10,000 Site Layout Plan

FIGURE 2.2

2.3. Detailed Description of Project

There are three main elements in this development. These are:

- **civil works,** including access and site roads and associated drainage works, turbine foundations and cable trenches:

  ◊ the *access route* to the site will be via the R521 from Foynes seaport to Newcastle West and then travelling on the N21 as far as the intersection with the R515 near Goulburn Bridge. The vehicles will travel along the R515 as far as Lots Road, where the site entrances are located. There may be some alterations at bends along the R515 to accommodate the HGVs. The extent of upgrading necessary will be agreed with Limerick County Council.

  ◊ *site tracks* will be required to connect the turbines and the control house to the access road. These will be 4.0m to 4.5m wide with a binding course but remaining unpaved. Any embankment material required would be drawn from excavated material where it is structurally suitable. It is estimated that approximately 6.1km of site tracks will be constructed.

  ◊ *hardstanding area,* adjacent to each turbine, of approximate size 15m x 20m, will be cleared and surface dressed with stone. These will be located adjacent to each turbine and used by the crane during the erection of each turbine.

  ◊ *drainage* will be required for the site roads, as well as for each turbine, and for the substation, and for the substation.

  ◊ *foundations* for the turbines will be constructed of reinforced concrete. They are likely to be of the order of 12m x 12m x 1.5m in size, although the exact specifications may change, depending on the results of a site investigation works at each turbine location.

  ◊ *a* control house will form part of the substation. It will be a single storey building with a number of rooms, used to house the electrical equipment. Details are provided in Drawing No. 2.

- **erection of the turbines:** The Lagerway LW70/1500 turbine is self-erecting. The self-erecting feature means that a 300 tonne crane is sufficient for the installation of the turbine. The heaviest part to be lifted is a section of the nacelle, which weighs 19 tonnes. The mobile crane is required for a shorter period than for conventional turbine installation; and

- **electrical works:** The turbine equipment will be connected to a 3kV/20kV transformer in the base of the tower. Through underground cabling, these transformers will be connected to a 20kV ring main leading to a 38kV transformer at the control house security compound. The compound will also contain ESB switch- gear at 38kV, and an ESB end mast. The control house will contain switchgear and control panels. Palisade security fencing, screened by suitable hedging or trees will surround the compound. An overhead 38kV line will connect with the 110kV substation at Trien, 15km to the west of the site. The exact route has not yet been determined by the ESB.

2.4. Construction Phase

Once planning permission is obtained and a grid connection secured, activity on site will commence with the construction of the site entrance, internal site roads and hardstanding areas.

As the internal site roads reach each turbine location and the substation location, hardstanding areas for the crane, turbine foundations and building foundation will be prepared. The site drainage system along the site roads will be constructed as the road advances. Once roads are completed, the trenching and laying of underground cables will commence.

Once completed, the installation of the turbines will commence. As each turbine is completed, the electrical connections will be made. The construction of the substation will be ongoing at this stage along with the work on the grid connection.

Once the turbines are erected, the substation and electrical system completed and the grid connection provided, turbines will be tested and commissioned.

2.4.1. Employment

Employment created by the proposed wind farm will come primarily during its development and construction phases and from the manufacturer of turbine components locally. The construction phase will last for 6 to 9 months, and will employ up to 20 workers.

- **R&D Staff, and the Hire of Consultants for Production of EIS**: the development of this project so far has given contract work to more than five people.

- **Construction: Roads, Foundations, Tower Assembly, Electrical Development of Site, Commissioning**: A local contractor will be engaged to carry out civil works, including the construction of site roads, laying of foundations and excavation of cable trenches. Concrete and other building materials will be sourced locally. Plant hire will be contracted locally. The electrical consultant and contractors for this project will be from the Munster region.

2.4.2. Material Requirements

Most of the material for site roads will be sourced on site from excess material from road cuts. If required, road building material will be sourced locally. There will be approximately 6.1km of internal site road constructed and 5,100m^2 of hardstanding. Assuming 0.2m of crushed stone is used to surface the internal site roads and hardstanding, 6,510m^3 of stone will be required. Most of the material used for the road construction will be sourced on site.

It is estimated that 1,224m^3 of crushed rock will be required to complete the turbine foundations. This may be an overestimate if competent bedrock is encountered at shallow depths. The amount of concrete required is estimated at up to 3,700m^3 to complete the foundations for 17 turbines, substation and the foundations for the various electrical components. Assuming each concrete truck has a 6m^3 capacity, 616 truckloads will be required.

Other building material required includes the following:

- blocks, sand and cement, roofing material, etc. for the substation building;
- bedding sand (1,525 m^3) for the underground cables; and
- 2m-high security fencing (140m).

The plant associated with the construction phase will likely consist of the following:

- track excavators (with rock breakers);
- tractors and trailers with cable laying jig;
- cranes;

- site dump truck;
- Water bowser; and
- Petrol/diesel powered generator.

The fuel consumption during the construction phase is estimated at 50,000 litres.

2.4.3. Temporary Site Structures and Facilities

During the construction phase it will be necessary to provide temporary facilities for the workers. These will include a site office, workers' welfare facilities, toilets, employee parking, fuel storage tank(s) and a contractor lock-up facility. The site office and welfare facilities will be of porta-cabin type construction. Toilet facilities will be a porta-loo. Electrical power will be provided by petrol/diesel powered generators and mains electric.

2.4.4. Traffic

Traffic generated in the construction phase is examined in Section 3.2.2

2.4.5. Wastes, Residues and Emissions

Where material is excavated for the construction of access roads and foundations excess soil will become available for reuse. This material will be used for the reinstatement of the site after construction, as well as for construction of the access roads. Construction noise will impinge on local residents, due to the proximity of the residences to the site. This is examined further Section 3.2 dealing with the environmental impacts of construction.

Domestic type wastes generated during the construction phase will be stored on site in enclosed skips. A local skip hire company will be employed to periodically dispose of waste at a licensed landfill facility.

2.5. Operational Phase

2.5.1. Employment

The operation of the wind farm will make a modest contribution to local employment, with 1 to 2 people likely to be engaged in management, operation and maintenance with additional contract work for repairs and maintenance.

2.5.2. Traffic

Operation of the wind farm is expected to generate 1 to 2 trips per week for routine inspection or minor maintenance. It is considered that this will have a negligible impact on traffic.

2.5.3. Wastes Residues and Emissions

One of the major strengths of a renewable energy proposal is the absence of wastes, residues, or emissions of any kind during its operation.

2.5.4. Lifespan

The turbines are designed to last 20 years. It is likely that they will last longer. If, after 20-25 years the turbines are obsolete, the developer will make a decision whether to replace or decommission the turbines. This decision will be made on economic and technical grounds, which are impossible to forecast so far in advance.

If it is necessary to decommission the turbines, a crane will be re-mobilised on site and each turbine disassembled. As all the component parts are bolted together, this process is relatively straightforward. The foundations can be broken out with track excavator and rock breaker or covered over. All materials will be taken off-site and the foundation areas levelled. The site would be allowed to re-vegetate naturally.

2.6. Impacts of the Proposed Development

The proposed wind farm will have impacts on the local community and various aspects of the environment. Sections 3 through 13 address the various aspects of the environment on which the development could potentially impact. For each aspect considered, the existing environment is described, the potential impacts identified and mitigation measures proposed to minimise those potential impacts.

3. HUMAN BEINGS

3.1. Human Beings in the Existing Environment

The proposed wind farm site is located between two villages, Templeglentan 2km to the north and Toornafulla 2km to the south. There are 50 properties within 1km of the proposed turbine locations.

A list of the dwellings and their respective distances to the nearest turbines are presented in Table 3.1. There are 18 residences within 500m of the nearest turbine, the closest of which is located at a distance of 361m. This residence is located along Lots Road, the road passing through the site.

The main areas to be examined with respect to the potential effects of the development on humans are noise, visual impact and health and safety issues. There may be short-term impact on local traffic while transporting and erecting the turbines. Visual impacts are discussed in Section 9 (Landscape and Visual Impact). Material assets are also of concern to the local community. This is discussed in Section 12 (Material Assets).

3.1.1. Noise

A noise survey was carried out on the 20th and 21st February 2001 at selected sensitive locations close to the proposed wind farm site to determine existing baseline noise levels. The survey was carried out using a Bruel & Kjaer Type 1 sound level meter (SLM) capable of measuring within ± 0.1 dB(A) in L_{Aeq} and sound pressure Levels (SPL) in A-scale with an octave filter. The instrument records the Leq, L_{10} and L_{90} percentiles simultaneously. The instrument was fitted with a ½-inch diameter microphone and calibrated in accordance with BS 4142: 1997. The microphone was fitted with a windshield and the SLM was mounted on a tripod at 1.5 m above ground level at least 3.5m from any reflecting surfaces.

Table 3.1 List of Dwellings within 1km of the turbines

Dwelling No.	Distance from Turbines (m)
1	828
2	768
3	748
4	721
5	479
6	491
7	444
8	454
9	547
10	623
11	630
12	577
13	576
14	461
15	423
16	409
17	407
18	420
19	433
20	492
21	556
22	612
23	870
24	505
25	496
26	491
27	487
28	496
29	528
30	573
31	653
32	722
33	821
34	806
35	739
36	753
37	942
38	752
39	521
40	573
41	564
42	566
43	613
44	906
45	995
46	571
47	440
48	422
49	361
50	890

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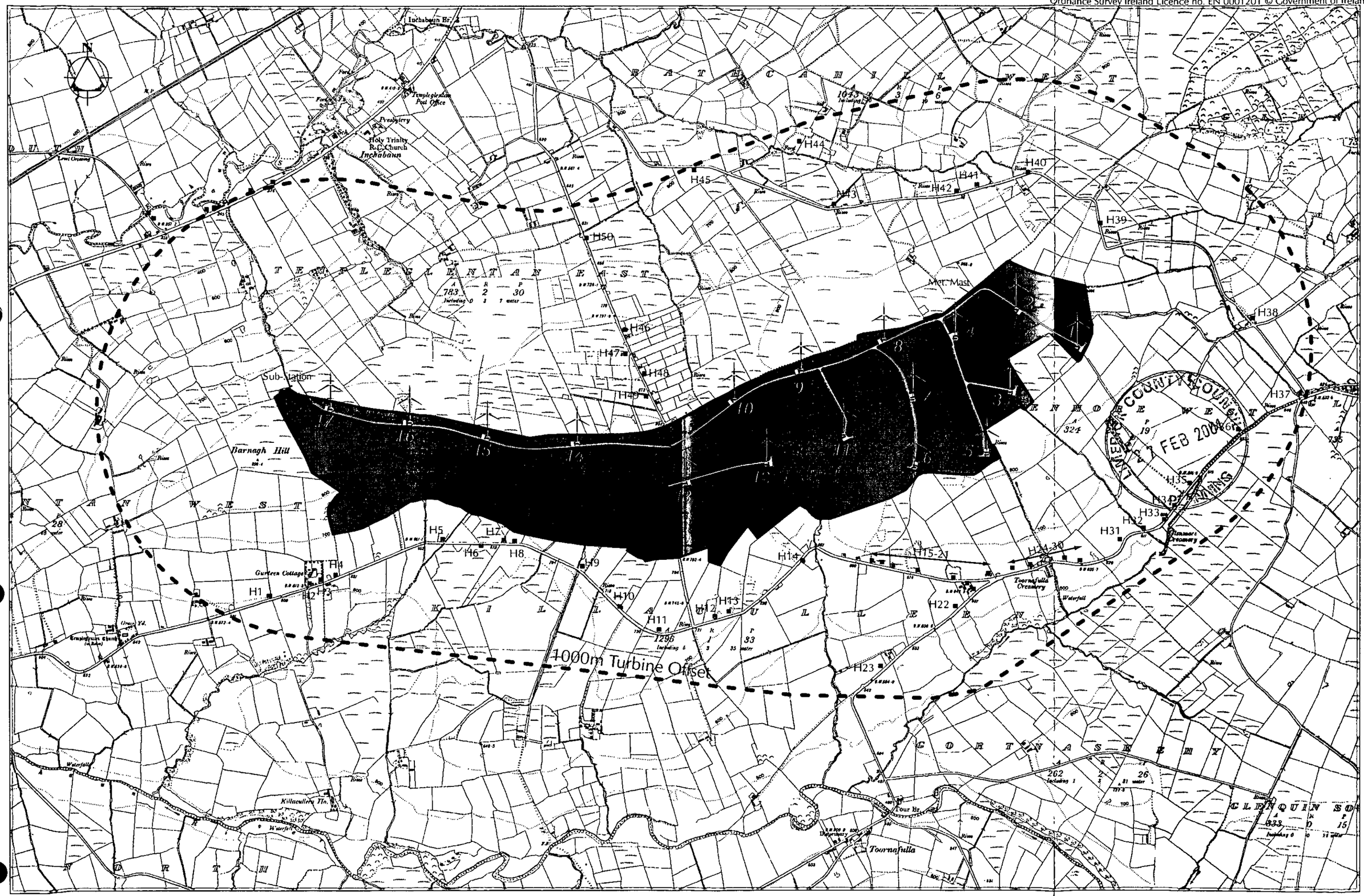

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1:15,000 Site Layout Plan Showing Houses within 1000m Turbine Offset

FIGURE 3.1

All measurement intervals were taken in accordance with ISO 1996 guidelines on noise monitoring, under suitable weather conditions (no rain and wind speeds of less than 5m/ses). Monitoring was carried out over 30 minutes for daytime and 15 minutes for nighttime monitoring. The wind speed at the time of monitoring ranged from 1 to 2.5m/sec. Recorded measurements are provided in Table 3.2. Monitoring locations (N1 to N5) are shown on Figure 3.2.

Table 3.2 Baseline Noise Measurements

Monitor Point	Description	Day-time 30 Minute			Night-time 15 Minute		
		L_{Aeq} dB(A)	L_{AF10} dB(A)	L_{AF90} dB(A)	L_{Aeq} dB(A)	L_{AF10} dB(A)	L_{AF90} dB(A)
N1	House No.48	49.5	51.4	34.6	48	39	27.6
N2	House No.16	60.3	53.6	35	48	36	23.2
N3	House No.7	52.2	45.8	29.2	48	38	25.4
N4	House No.31	51.3	54.2	35	29.4	31.8	22.6
N5	House No.42	45	46	37	30.6	32.2	28.4

The terminology used to express noise levels is defined as follows: -

L_{Aeq} is the average noise level recorded over the sampling period. The closer this value is to either the background (L_{AF90}) or the L_{AF10}, indicates the relative impact of the intermittent sources and their contribution.

L_{AF10} refers to those noise levels in the top 10 percentile of the sampling interval. It is the level that is exceeded for 10% of the measurement period. It is used to determine the intermittent high noise level features typically associated with traffic.

L_{AF90} refers to those noise levels in the lower 90 percentile of the sampling interval. It is the level that is exceeded for 90% of the measurement period. It will therefore exclude the intermittent features typically associated with traffic noise, and is used to estimate the background level.

The survey data was used to predict the potential impact of the wind turbine noise on the environs and in particular on local sensitive areas. A number of sampling locations were selected as being representative of the noise sensitive locations, as follows:

N1: A residential property (House No. 48) located along Lots Road.

The sound of birds, dogs barking, and traffic on the road outside contributed to the noise levels at this location during daytime monitoring. The main noise source was from a radio in a nearby garage. The main noise source recorded during nighttime monitoring was the intermittent running of a central heating system at nearby house.

N2: A residential property (House No. 16) located south of the site along the R515.

The sound of work being carried out in a nearby garage was the dominant noise source. Traffic passing along the road was also significant during daytime monitoring. The main noise source recorded during nighttime monitoring was from passing traffic, dogs barking and from a central heating system.

N3: A residential property (House No. 7) located south-west of the proposed site along the R515.

The main daytime noise source was from the central heating system at a nearby house and traffic on the road outside. The main noise source recorded during nighttime noise monitoring was from activities being carried out in a nearby garage and traffic along the road.

N4: A residential property (House No. 31) at the south-east of the site along the R515.

The sounds from birds, dogs and the passing traffic along the road contributed to daytime noise levels. The main noise source recorded during nighttime monitoring was from distant traffic.

N5: A residential property (House No. 1) to the north-west of the proposed wind farm.

Dogs barking in the area, the sound from roadside streams and cattle in nearby sheds contributed to the daytime noise levels recorded here. Two cars passed during the 30-minute monitoring period. The main noise source recorded during nighttime monitoring was from distant traffic.

The noise levels recorded at the above locations are typical of rural areas. The levels recorded along the R515 regional road were higher than those along the minor roads. This was mainly due to the volume of passing traffic and the number of houses in close proximity contributing to the noise. Along the minor roads, the main noise sources were from farmyard animals, wildlife, dogs barking and water flowing in nearby streams, in addition to the occasional passing car.

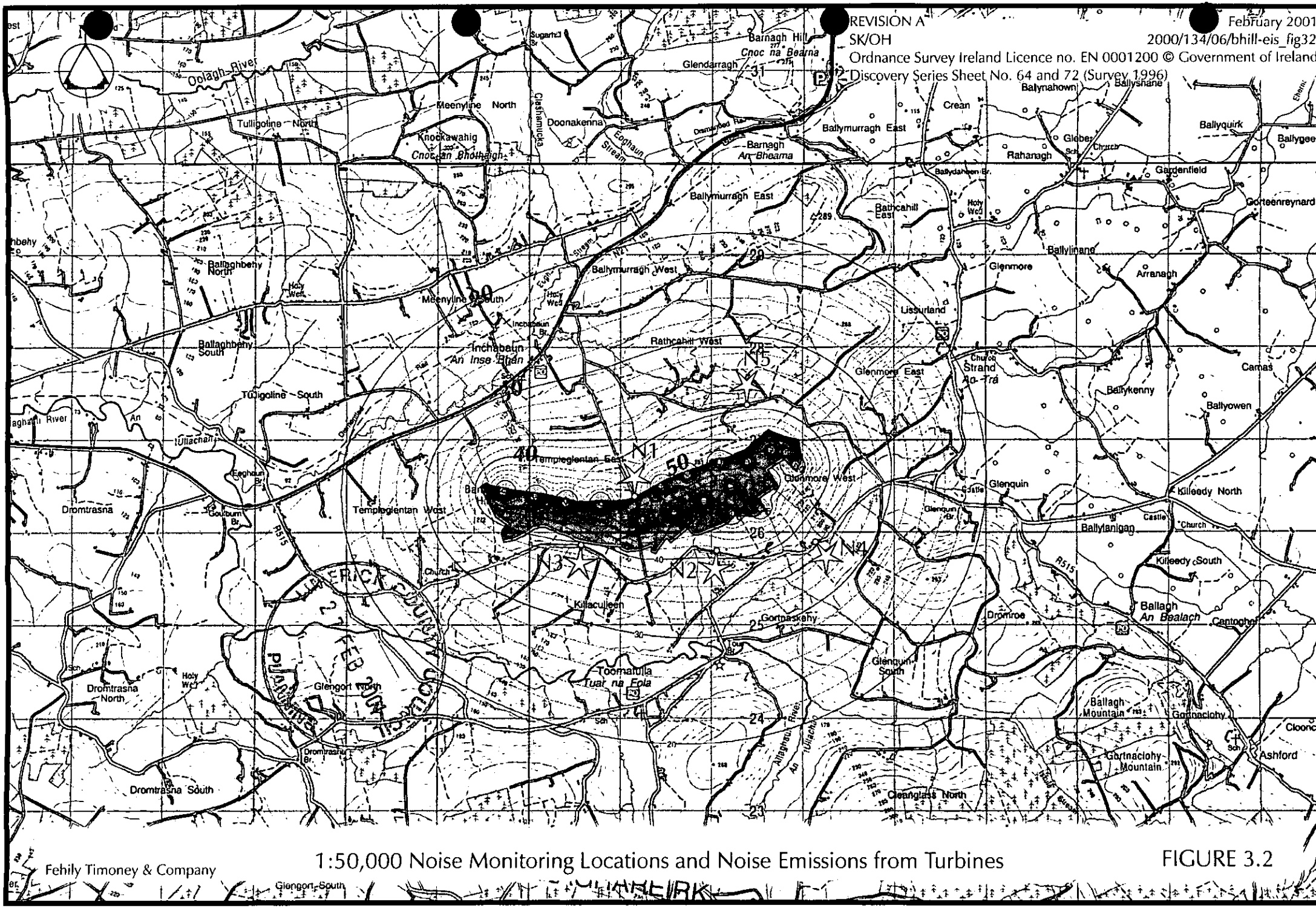
During the nighttime monitoring, traffic levels along the R515 monitoring locations were significantly reduced. The main noise sources were from normal background rural sounds. Nighttime noise measurements taken at locations along the minor roads were also considerably lower for the same reasons.

3.1.2. Traffic

The site is located along a rural country road used by local landowners and commuters between Templeglentan and Toornafulla. The site joins the R515 to the south and the N21 to the north.

The National Road Authority (NRA) conducted a traffic survey on the N21 between Abbeyfeale and Newcastle West in 1997. The results of the traffic survey indicate that the existing annual average daily traffic (AADT) passing this location is 6178 vehicles/day. The traffic counted on the day comprised of cars (88% of the total AADT) and heavy goods vehicles, HGVs (12% of the total AADT).

Since the monitoring location is along the main proposed route for the construction traffic, with only minor roads branching off this regional road leading to the site, no additional traffic surveys were carried out.



Fehily Timoney & Company

1:50,000 Noise Monitoring Locations and Noise Emissions from Turbines

FIGURE 3.2

3.2. Characteristics of the Development Which Could Impact on Human Beings

3.2.1. Noise

Historically the impact of noise on houses in the vicinity of wind farms has been a very important consideration. As a result of improvements in technology, however, the noise generated by turbines has decreased substantially.

Potential noise sources from the wind farm, which could affect human beings, include: -

- plant operations during internal site road construction;
- construction traffic to and from the site;
- crane operation while erecting the turbines; and
- operation of the turbines once the site is commissioned.

Of the potential noise sources listed above, operation of the turbines is anticipated to generate the least amount of noise.

Sound power levels from construction plant (excavators and dozers) are in the order of 85dB(A) L_{Aeq} at 10m. Doubling the distance from the source reduces the sound level by 6dB. Since the nearest occupied residence is 361m from the nearest turbine (residence No. 49), the sound level is predicted to be just under 55dB(A). This is just under the daytime limit for noise of 55dB(A). However the majority of the work will be carried out at a greater distance from this residence further attenuating the construction noise.

There are two forms of noise which may originate from wind turbines; mechanical and dynamic noise. The swishing sound from the turbine blades as they pass through the air gives rise to the aerodynamic noise.

Lagerway turbines have a direct drive system, which has only one rotating component. There is no gearbox, therefore the rotation speed of the blades is lower (18-22rpm). The turbine is also a variable pitch turbine, adding to the efficiency of the turbine. These two factors contribute to the LW70/1500 low sound power level of 99dB(A) in contrast to similar size turbines by other manufacturers, which can have sound power levels of 102dB(A) or higher.

Table 3.3 below is taken from The Scottish Office, Environmental Department, Planning Advice Note on Wind Power[27]. It shows that the sound of a wind farm in operation is less than that of normal road traffic or from a busy office.

While the turbine sound does increase with windspeed, normal background noise such as the rustling of trees and the sound of wind itself also increases, thereby drowning out any increases in noise levels from the wind farm.

Table 3.3 Comparative Noise Levels

SOURCE/ACTIVITY	INDICATIVE NOISE LEVEL dB(A)
Threshold of hearing	0
Rural night-time background	20-40
Quiet bedroom	35
Wind farm at 350m	35-45
Car at 40mph at 100m	55
Busy general office	60
Truck at 30mph at 100m	65
Pneumatic drill at 7m	95
Jet aircraft at 250m	105
Threshold of pain	140

Noise Level Prediction

Reflection or the absorption of sound from the terrain or buildings gives rise to different sound levels at different locations. Generally, less sound is heard upwind of wind turbines. The wind rose is therefore important to chart the potential dispersion of sound in different directions. The predominant wind direction is from the south-west. To predict the effect of 17 turbines, a noise model was run using the WIND FARM Release 3 wind farm modelling package. The 50 residences located with 1km of the turbines were used in the model. As a rule-of-thumb 500m distance to the nearest dwelling is used to assess the potential noise impact, the 1km distance used is considered more than sufficient to assess potential impacts on dwellings from noise emissions. The nearest resident is located approximately 361m from the nearest turbine.

Other factors affecting the propagation of sound, and its attenuation, include weather conditions, physical barriers/screens, absorption of sound and distance from source to receiver. Only the latter is used in the prediction model.

The noise model used to calculate the noise level at a house due to the turbine operation is based on "Description of Noise Propagation Model Specified by Danish Statutory Order on Noise from Windmills (1991)"[28].

For modelling purposes, a sound power level of 99dB(A) was used. This level was theoretically calculated by the turbine manufacturer at a reference windspeed of 8m/sec taken at a hub height of 65m.

Individual noise predictions were made at a number of residences around the site. These are presented in Table 3.4 (daytime) and Table 3.5 (nighttime).

The model was run on the assumption that there are no tonal components to the noise emissions from the turbines. A line of sight between the turbines and residences is also assumed and topography data is not considered in the calculation. The model illustrates the attenuation of noise emissions from the turbines with distance. This noise level is given on Table 3.4 and Table 3.5 and illustrated graphically in Figure 3.3. Given that it does not take into account topographical or other screening effects of hedges, sheds, etc., it represents the worst case scenario.

In line with BS Standards, background noise measurements were carried out at wind speeds of less than 5m/sec while the noise prediction model was run using noise data specified by a turbine manufacturer at average wind speeds of 8m/sec at 10m height. At wind speeds of 8m/sec, the background noise levels will be much higher such that the increase in noise levels (from background) during the operational phase will be much less. It is noted that the turbines will not operate at wind speeds of less than 4m/sec when background noise will be at its lowest. Figure 3.3 is a schematic illustration used to show how, with increasing wind speeds the natural background noise drowns out noise emissions from the wind farm.

Figure 3.3 Diagrammatic Illustration of Noise Level Changes with Wind Speed

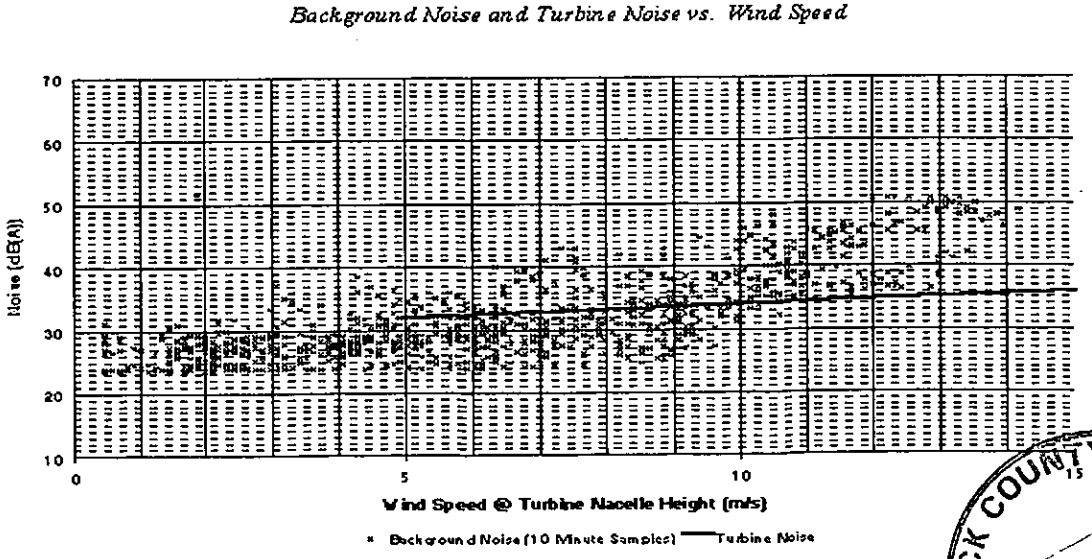


Table 3.4 Predicted Noise Levels During the Operational Phase (nighttime)

Dwelling No.	Predicted Noise from Turbines at Dwelling (Model Output)	Ambient Noise (L_{Aeq})	Background Noise (L_{af90})	Predicted Noise - Ambient (L_{aeq})	Predicted Noise - Background (L_{af90})
1	32	48	25	48	33
2	34	48	25	48	34
3	34	48	25	48	35
4	35	48	25	48	35
5	39	48	25	49	40
6	39	48	25	49	39
7	40	48	25	49	40
8	40	48	25	49	40
9	39	48	25	49	39
10	37	48	25	48	37
11	37	48	25	48	37
12	38	48	23	48	38
13	38	48	23	48	38
14	41	48	23	49	41
15	42	48	23	49	42
16	42	48	23	49	42
17	42	48	23	49	42
18	41	48	23	49	41
19	41	48	23	49	41
20	40	48	23	49	40
21	39	48	23	49	39
22	38	48	23	48	38
23	35	48	23	48	35
24	40	29	23	40	40
25	39	29	23	40	40
26	39	29	23	40	39
27	39	29	23	40	39
28	39	29	23	40	39
29	39	29	23	39	39
30	38	29	23	38	38
31	37	29	23	38	37
32	36	29	23	37	37
33	35	29	23	36	36
34	35	29	23	36	35
35	36	29	23	37	36
36	34	29	23	36	35
37	32	29	23	34	32
38	34	29	23	35	34
39	39	30	28	40	39
40	38	30	28	39	38
41	39	30	28	39	39
42	39	30	28	40	39
43	38	30	28	39	39
44	35	30	28	36	36
45	34	30	28	36	35
46	39	30	28	49	40
47	41	48	28	49	41
48	42	48	28	49	42
49	43	48	28	49	43
50	35	48	28	48	36

Table 3.5 Predicted Noise Levels during the Operational Phase (daytime)

Dwelling No.	Predicted Noise from Turbines at Dwelling (Model Output)	Ambient Noise (L_{Aeq})	Background Noise (L_{Af90})	Predicted Noise - Ambient (L_{Aeq})	Predicted Noise - Background (L_{Af90})
1	32	52	29	52	34
2	34	52	29	52	35
3	34	52	29	52	35
4	35	52	29	52	36
5	39	52	29	52	40
6	39	52	29	52	39
7	40	52	29	53	40
8	40	52	29	53	40
9	39	52	29	52	39
10	37	52	29	52	38
11	37	52	29	52	37
12	38	60	35	60	40
13	38	60	35	60	40
14	41	60	35	60	42
15	42	60	35	60	43
16	42	60	35	60	43
17	42	60	35	60	42
18	41	60	35	60	42
19	41	60	35	60	42
20	40	60	35	60	41
21	39	60	35	60	41
22	38	60	35	60	40
23	35	60	35	60	38
24	40	51	35	52	41
25	39	51	35	52	41
26	39	51	35	52	41
27	39	51	35	52	41
28	39	51	35	52	41
29	39	51	35	52	40
30	38	51	35	52	40
31	37	51	35	52	39
32	36	51	35	51	39
33	35	51	35	51	38
34	35	51	35	51	38
35	36	51	35	51	38
36	34	51	35	51	38
37	32	51	35	51	37
38	34	51	35	51	37
39	39	45	37	46	41
40	38	45	37	46	40
41	39	45	37	46	41
42	39	45	37	46	41
43	38	45	37	46	41
44	35	45	37	45	39
45	34	45	37	45	39
46	39	50	35	50	41
47	41	50	35	50	42
48	42	50	35	50	43
49	43	50	35	50	44
50	35	50	35	50	38

Criteria for Noise Emissions from Wind Farms

In the absence of legislation on noise from wind farms, the Wind Energy Development Best Practice Guidelines[29] document was reviewed. There are however, no noise emission levels given for comparison purposes. It gives general guidelines on noise from turbines and states that turbines should be sited far enough from houses for noise emission not to be a nuisance.

Other sources of noise emission criteria reviewed include: -

- Department of Environment – Wind Farm Development Guidelines for Planning Authorities;
- the Irish Planning Institute – 'Planning Guidelines for Wind Energy'; and
- the UK Department of Trade and Industry – Wind Turbine Noise Work Group.

The Department of the Environment guidelines suggest a noise limit of 40dB(A)L_{eq} and that tonal or impulsive qualities in the noise should be avoided.

The Irish Planning Institute "Planning Guidelines for Wind Energy[30]" identifies noise as the second most sensitive aspect of wind farms after visual impacts. To avoid impact from noise, a distance of 500m is generally recommended, although this guideline distance may vary from site to site. The Limerick County Development Plan cites the same recommendation. The least distance from turbine to residence at the Toornafulla site is 361m. The guidelines suggest a 40dB(A) L_{Aeq} sound level at a dwelling when the measured wind speed at hub height is 5m/sec and 45dB(A) L_{Aeq} at a windspeed of 8m/sec at the hub height of the nearest turbine. It is also suggested that noise emissions not be tonal or impulsive and that post-construction monitoring be carried out. It is unclear whether these figures quoted refer to the additional noise from the wind farm or the predicted noise level resulting from the existing environment and the wind farm. In many cases, even in a rural environment, ambient noise levels can be greater than 40 or 45dB(A) even before a wind farm is constructed. Another difficulty in the comparison of these guidance values with the predicted values is the variation in referenced wind speeds. Turbine manufacturers use a wind speed of 8m/sec at 10m while the planning guidelines reference wind speeds of 5m/sec and 8m/sec at hub-height, which is typically in the order of 55m.

The Wind Turbine Noise Working Group[31] established by the Department of Trade and Industry (DTI), has extensive experience in the assessment and control of the environmental impact of noise from wind farms. Their report, the Measurement and Rating of Noise from Wind farms, was consulted regarding the analysis and interpretation of background noise.

The DTI Noise Working Group proposed to limit the noise from a wind farm relative to the existing background noise but with special consideration given to the very low noise limits that would apply in particularly quiet areas. It is suggested that noise from the wind farm should be limited to 5dB(A) above background for both day and nighttime. It should be noted that this limit applies to the noise from the wind farm only and not to the total ambient noise with the wind farm operating. In high winds, bangs and clatters from existing sources and gusts of wind are likely to be more significant than the wind farm noise.

It is considered that a margin of 5dB(A) will offer a reasonable degree of protection to both the internal and external environment without unduly restricting the development of wind energy which itself has other environmental benefits.

However, applying the "margin-above-background" approach to some very quiet areas would imply setting noise limits, which would prove very restrictive on the development of wind energy. It is not necessary to restrict wind turbine noise below certain lower fixed limits in order to provide a reasonable degree of protection to the amenity.

During the night one can reasonably expect most people to be indoors and it will not be necessary to control noise to levels below those required to ensure that sleep is not disturbed. A nighttime absolute lower limit is therefore appropriately based upon sleep disturbance criteria.

The Noise Working Group recommends that an appropriate limit for the nighttime is 43dB(A). This limit is derived from the 35dB(A) sleep disturbance criteria. An allowance of 10dB(A) has been made for attenuation through an open window (free field to internal) and 2dB subtracted to account for the use of L_{AF90} rather than L_{Aeq} (assuming the L_{AF90} of turbine noise is 1.5-2.5dB(A) below the L_{Aeq}).

The Working Group recommends limiting the noise from the wind farm during the day to a limit of 40dB(A) also.

Discussion of Results

The five nighttime background noise levels recorded around the site varied from 23-28dB(A). The model (Table 3.4 Column 2) indicates that the predicted noise levels from the turbines at these dwellings range from 31-43dB(A). The predicted noise for the nearest residence to the site is 43dB(A).

The 43dB(A)-guideline set by the DTI is not exceeded at any residence. However, at all 50 residences there is an increase of 5dB(A) above background level.

The Department of Environment guideline of 40dB(A) for ambient noise is exceeded at 9 residences.

Regarding the Irish Planning Institutes recommendations, the following points are made;

- eighteen residences are within 500m of the nearest turbine;
- three of the five ambient noise measurements recorded around the site are above the 40dB(A) suggested. It is noted that these measurements were taken at wind speeds of less than 5m/sec. It is therefore unreasonable to impose an upper limit of 40dB(A) for a wind farm, when the natural noise levels alone are likely to exceed this value. Predicted noise levels from the turbines are above this value at 9 dwellings; and
- the noise emissions from the turbines are calculated for wind speeds of 8m/sec. The predicted noise levels from the turbines do not exceed the guideline value of 45dB(A) at any dwelling.

The five daytime background noise levels recorded around the site varied from 29-37dB(A). The model (Table 3.5 Column 2) indicates that the predicted noise levels from the turbines at these dwellings range from 31-43dB(A). The predicted noise for the nearest residence to the site was 43dB(A).

The DTI Noise Working Group recommendation of restricting background daytime noise to a maximum of 40dB(A) was exceeded at 9 residences. There is an increase of 5dB(A) above background level at 9 residences.

The Department of Environment Guideline of 40dB(A) for ambient noise is exceeded at 9 residences.

Regarding the Irish Planning Institutes recommendations, the following points are made;

- all of the five ambient noise measurements recorded around the site are above the 40dB(A) suggested. It is noted that these measurements were taken at wind speeds of less than 5m/sec. It is therefore unreasonable to impose an upper limit of 40dB(A) for a wind farm when the natural noise levels alone are likely to exceed this value; and

- the noise emissions from the turbines are calculated for wind speeds of 8m/sec. The predicted ambient noise at 44 residences exceeded the guideline value of 45dB(A).

In summary, the predicted data represents the worst case scenario with respect to noise levels. At each dwelling, the combined noise output from the 17 turbines is used to predict noise levels. The model also does not account for topography or local screening. The model also uses predicted noise levels at wind speeds of 8m/sec whereas the baseline noise measurements were carried out at wind speeds of less than 2m/sec. At higher wind speeds the natural noise level will increase. The noise from the turbines will be less obvious under these conditions.

3.2.2. Traffic

It is estimated that approximately 140 HGVs will be required to transport the 17 turbines to the site. While the number of HGVs in itself is not significant, the loads are oversized and as such will involve co-ordination with local authority and the Gardai. The proposed route of delivery is from Foynes seaport to Newcastle West and the N21 via the R521. Approximately 3km to the west of Templeglentan, the proposed route will turn to the south from the N21 to the R515. The route will follow the R515 for 5km before turning north onto Lots Road.

The transport of the crane and jib will also be an oversized load requiring traffic control.

Construction Traffic

There will be an increase in local traffic during the construction phase of the project. Workmen, including plant operators, electricians, engineers and tradesmen, will be commuting to and from the site each morning and evening. It is estimated that as many as 20 workers may be on site during times of maximum activity. Assuming each travels separately, 20 vehicles will use the local access roads. Predicted construction traffic numbers are presented in Table 3.6.

Table 3.6 Construction Traffic Estimates

Construction Item	Maximum Number/Volume Required	Associated Traffic	Comment
Towers	17 No.	51 loads	Assumes 3 sections per tower.
Nacelle	17 No.	17 loads	
Blades	51 No.	51 loads	Container length would be up to 10 m longer if more than 1 blade was carried at a time.
Tower Bases	17 No.	17 Loads	Assumes 1 per truckload.
Electrical Components	Varies	10 loads	Transformers, switch gear, cable, etc.
Concrete	3,700 m^3	616 loads	Assumes 6m^3-load capacity.
Stone	1,224 m^3	Varies	Assumes bedrock not encountered.
Bedding Sand	1,525 m^3	120 Loads	Assumes 0.25m^3 per metre run used.
Building Material	Varies	20 loads	Blocks, sand, cement, roofing, fencing, re-bars, etc.
Crane	1 No.	2 loads	300 tonne crane.
Employees	20 persons	20 vehicles	Will vary depending on activities.
Fuel	50,000 litres	250 loads	Assumes 2 1,000-litre tanks on site.
Plant	Varies	Varies	See Section 2.3.3.

Another aspect of traffic is the likely increase due to on-lookers as the turbines are erected. This increase will likely occur at weekends, but be intermittent, thus not creating any significant impact to local traffic patterns. When operational, there will be no significant impact from traffic other than for routine maintenance.

Once commissioned, the site will provide employment for one caretaker worker, with occasional visits from maintenance workers. The impact of this on local traffic will be negligible.

3.2.3. Health & Safety

The wind farm will be designed, constructed, operated and decommissioned in accordance with the Safety, Health & Welfare at Work (Construction) Regulations 1995 and the Irish Wind Energy Association (IWEA), Best Practice Guidelines.

However, aspects of the development will present health and safety issues. These will be primarily during the construction phase. The aspects of the development where health and safety issues are of particular importance are as follows: -

Construction

- traffic safety during the transport of oversized loads to (and from the site);
- lifting of heavy loads overhead using cranes;
- working with electricity during commissioning;
- working at heights; and
- general construction site safely (i.e. slip/trip, moving vehicles etc.)

It is not the intention of this list to minimise the safety issues of any activity associated with the project, as all are important.

There may also be a concern for visitors to the site both during the construction phase and operation phase. It is not feasible to erect a security fence around the entire site due to the site size. Access to the site during the construction phase will be restricted in a manner similar to any construction site. During the operation phase, site access will only be restricted to the substation compound. Visitors to the site will be able to walk onto the site and approach the turbines, although this will be discouraged. The turbines selected will maintain a 'blade over-ground' clearance of at least 30m.

Operation

Under normal conditions, access to the site and turbines are very safe for people and animals. Sheep and cattle may continue to graze on the site during operation. There are no fences or barriers restricting access other than the security fence around the compound of the substation and the hedgerows and fencing defining field boundaries.

Access to the turbines is through a hatch door at the base of the structure. This will be locked at all times.

It is not anticipated that the workings of the turbines will present any danger to the public. The components of a wind turbine are designed to last 20 years and are equipped with a number of safety devices to ensure safe operation during their lifetime. These include: -

- a vibration sensor will detect if a turbine starts shaking and turns the turbine off;
- other sensors in the nacelle to check the operation of the turbine;

- static testing of rotor blades;
- dynamic testing of the blade's ability to withstand fatigue from repeated bending;
- independent fail-safe brake mechanisms to stop the turbine. The aerodynamic braking system is the main braking system while mechanical braking serves as a backup system. The turbines will shut down at wind speeds exceeding 25m/sec; and
- the turbines are also fitted with lightening protection mechanisms to counteract any lightening strikes.

The rigorous safety checks imposed on the turbines during design, construction and commissioning should ensure the risks imposed to humans are negligible.

The turbine is a generator, which generates electricity at low voltage; emitting a negligible amount of electromagnetic radiation. It emits no more electromagnetic radiation than, for example, a diesel generator. There is no known risk to human beings from the electromagnetic emissions from wind turbines.

Shadow Flicker

In times of direct sunshine, wind turbines can produce a flickering effect, which may impact on residents living in close proximity to the turbines. This is caused by the rotor blades chopping the sunlight while the rotor is in motion.

At certain times of the year, the moving shadow may periodically impact the light to a room causing the natural light to flicker.

Shadows are most prominent at dawn and dusk, when the turbines cast long shadows. Under conditions of clear skies, a low sun angle and rotating turbine blades, shadow flicker may result if rotating blades "chop" the sunlight. It is generally recommended that a distance at least 6-8 rotor diameters, in this instance 560m, be allowed from the turbines to the nearest house. There are 50 houses within 1km of the turbines, the nearest house is located approximately 361m from the nearest turbine.

To assess the impact of shadow casting from the proposed development on the residents in proximity to the site, a shadow flicker model was run using the Wind Farm modelling package for all 50 residences.

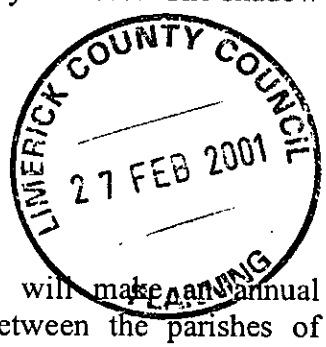
The model calculates times throughout the year when a turbine rotor disc viewed from the window of a house is in line with the sun and therefore the potential for shadow flicker exists. Due to the very large number of houses around the site, a worse case scenario for each house was applied (i.e., it was assumed that each house has a number of windows from which clear views of the turbines could be viewed). The model does not consider screening in its calculation of shadow flicker.

Of the 50 houses modelled, 35 will potentially be affected by shadow from the turbines. The residences most potentially affected are residence No. 39, located to the north-east (46hrs per year), residences Nos. 47 (64hrs per year), 48 (90hrs per year) and 49 (106hrs year).

It is important to note that for shadow flicker to occur, there are a number of physical requirements that must occur simultaneously: -

- clear skies, no shadow flicker will occur in cloudy conditions;
- the turbines must be facing in the direction of the sun. If the wind is not blowing in a direction parallel to that of the sun's rays, then no shadow flicker will occur; and
- the house must have a window looking in the direction of the sun with the turbine in the line of sight of the window.

It is reasonable to consider that these requirements will be fulfilled for only a small percentage of the time for which the model predicts shadow flicker will occur. The actual incidence of shadow flicker will therefore be considerably reduced. The shadow flicker model results are presented in Appendix E.



3.2.4. Socio Economic Impacts

Eirtricity Developments Ltd. proposes that the wind farm will make an annual contribution of 1% of its gross earnings to be divided between the parishes of Toornafulla and Templeglentan, estimated at £25,000 per annum (assuming planning would be granted for all 17 turbines) . Over the design life of the turbines (20 years) this will amount to £0.5 million. This will have the greatest long-term positive impact on the local economy.

The design, construction and operation of the wind energy project will provide employment to the local community. The design and planning stage will provide employment for a number of technical consultants. This will be relatively short-term (i.e. 4 to 6 months).

The construction phase will provide employment for local tradesmen, labourers and specialised contractors, perhaps from other areas of the country. This will have a direct short-term positive impact on the local economy.

The operational phase will present an opportunity for local mechanical-electrician contractors to become involved with the maintenance programmes for this wind energy project. It is also anticipated that the project will provide part-time employment for 1 or perhaps 2 persons providing caretaker services.

There will be a significant rates income for Limerick County Council. This income will be put to beneficial use for the County as a whole.

3.2.5. Tourism

The Planning Authority has formulated a "Designated Tourism Areas Strategy". The areas selected are;

- 3 main Tourist Routes-N69, N20 and N21;
- areas in the vicinity of major tourist attractions (as determined by visitor numbers);
- areas where views and prospects are listed; and
- attractive settlements such as Adare, Askeaton, Bruree, Galbally, Glin, Kilmallock and Castleconnell.

The N21 is classified as a tourist route and is located 2km to the north of the site. There are no tourist/recreational areas in the immediate vicinity of the site. The nearest are located in Newcastle West (8km), on which the site will have little impact. A number of photomontages have been prepared for locations on the N21. These are presented and discussed in Section 9.

There are a number of views and prospects of scenic importance in the vicinity of the site. These are:-

- sugar Hill;
- mullaghareirk Mountains; and
- barnagh Gap.

Sugar Hill is located approximately 6km to the north of the site at an elevation of 320mOD. There will be clear views of the site from this area. This viewpoint is discussed in greater detail in Chapter 9 and a photomontage representing the visual impact has been prepared.

The Mullaghareirk Mountains are located to the south of the site at an approximate distance of 4km. Again, due to the elevation of these mountains, there will be clear views of the site.

Barnagh Gap is located over 4km to the north-east. However the viewing direction is away from the wind farm with viewing prospects towards Newcastle West.

There are no listed attractive settlements in the vicinity of the site.

With respect to tourism of the area, there is no evidence to suggest that wind farms detract tourists from areas. Indeed many wind farms have an important educational role and are themselves tourist attractions.

3.3. Mitigation Measures

3.3.1. Noise

To mitigate against the impacts of noise on the local community, the following mitigation measures are proposed: -

- limit the working hours at the site during the construction phase to 08:00 to 19:00 Monday through Saturday inclusive. Work on Sundays or Bank Holidays will only be conducted in exceptional circumstances or emergency;
- the use of state of the art wind turbines, which are specifically designed to minimise noise emissions;
- the manufacturer specifications for the noise emissions from the Lagerway turbines are 99dB(A) at hub height with a wind speed of 8m/sec. The predictive model indicates that the highest noise level at the nearest residence will be 43dB(A);
- noise impacts associated with movement of oversized loads during off-peak hours (night-time and early morning) will be controlled by imposing a speed restriction of 15mph for all vehicles on this access road during night-time movements, transport of oversized loads in convoys to limit the frequency of disturbance, notifying the locals in advance when movements are scheduled and ensuring that all vehicles are in good mechanical order.

In addition, monitoring of noise levels after commissioning will be carried out.

3.3.2. Traffic

To mitigate against the impacts of traffic associated with the project, the following mitigation measures are proposed: -

- provision of traffic control while transporting oversized loads to the site. Movement of oversized load will be co-ordinated with the local authorities and the Gardai;
- movement of loads during off-peak hours;
- parking facilities will be provided on site for construction traffic; and
- sourcing as much material as possible on-site for site track and hardstanding construction to minimise the volume of construction traffic to the site.

Regular vehicle traffic to and from the site will have negligible impact. On a long-term basis, once the site is in operation, it is anticipated that the development will not generate any adverse impacts on traffic in the vicinity of the site. Mitigation measures other than partial upgrading of sections of the local road are not deemed necessary.

3.3.3. Health and Safety

A site-specific health & safety statement for the construction phase of the project will be prepared in accordance with the Safety, Health & Welfare at Work (Construction) Regulations 1995. This will address all issues of the construction project including general site safety, protective clothing and footwear required, crane operation, heavy equipment operation, lockout/tag-out procedures for safe electrical work, scaffold and working from heights. The site manager will be responsible for the implementation of procedures outlined in the safety statement. Traffic safety is discussed in Section 3.3.2.

Public safety will be addressed by restricting site access. Appropriate warning signs will be posted, directing all visitors to the site manager.

As stated in Section 3.2.5, electromagnetic radiation levels from wind turbine are negligible and have no known health effects. No mitigation measures are therefore suggested.

The substation on site will be fenced, restricting unauthorised access.

3.3.4. Shadow Flicker

Shadow flicker will potentially affect twelve residences for more that 20 hours per year. These residences are located mainly to the south along the R515 but also along Lots Road and the road to the north. The model represents the worse case scenario. Natural screening by trees around houses will mitigate against shadow affecting many of these residences. For residences with unobstructed views of the site, the developer undertakes to mitigate for the impacts of shadow flicker by screen planting.

3.3.5. Socio-Economics

The main socio-economic impact will be the annual contribution of 1% of the proposed wind farm's gross earnings to the local community divided between Toornafulla and Templeglentan parishes. This will have a significant positive impact on the local communities.

Six local landowners will also benefit from diversifying land use. Their lands can also continue to be used for pasture with little loss of available land use.

The development will provide employment to the local community during the construction phase. No mitigation measures are deemed necessary.

4. GEOLOGY AND HYDROGEOLOGY

4.1 Introduction

The proposed site is located near the village of Toornafulla and covers an area of approximately 184ha, as shown in Figure 2.1. It extends eastwards from Barnagh Hill (272mOD) and encompassing adjacent peaks (277mOD) and 283mOD). Barnagh Hill is a northward extension of the Mullaghareirk Mountains, a range of which forms a large area of north-west County Cork extending into Counties Limerick and Kerry. The Allaghaun River and associated valley runs approximately west separating Barnagh Hill and the main body of the Mullaghareirk Mountains.

In general the area can be described in terms of two topographical variations which reflect the underlying bedrock geology. Low-lying regions to the east of Barnagh Hill such as the land around Newcastle West are underlain by Carboniferous Limestone. Barnagh Hill and the Mullaghareirk Mountains, to the south, are underlain by Upper Carboniferous (Namurian) shales and sandstones. This 'later' Namurian siliclastic rock extends northwards to the River Shannon and into County Clare.

4.1. Bedrock Geology

Geological mapping published by the Geological Survey of Ireland indicates that the site is underlain by two geological formations. Further east of the site boundary, flanks of the uplands slope into lowlands underlain by limestone dominated bedrock.

Briefly bedrock geology can be discussed in terms of four units:

- the Central Clare Group;
- the Shannon Group;
- the Clare Shale Formation; and
- the Visean Limestones.

The Central Clare Group underlies a large portion of the north-west County Limerick and comprises laminated shale, siltstone and sandstone units. The unit is characterised by coal horizons and in the past a seam was worked in the Crataloe Coalfield located north of Abbeyfeale. A small north-west to south-east seam is believed to exist beneath part of the southern site boundary.

The Shannon Group is believed to underlie some of the eastern areas of the site. This group comprises mudstones, siltstones and sandstones. The group is similar in nature to the Central Clare Group though it is not believed to contain coal horizons.

The Clare Shale Formation is found approximately 2km east of the site boundary and underlies the steeply dipping slopes at Glenmore East and Glenquin. This formation comprises dark grey shales, with siliceous mudstones towards the base.

The Visean and Limestones underlie the lowlands east of the site. Although elsewhere in the region Visean limestone has been sub-divided into different formations, the lack of rock exposure and drilling information means that this limestone dominated bedrock is described as Visean - undifferentiate.

4.2. Quaternary Geology

During the last glaciation the region was extensively influenced by the passage of ice masses. The Irish ice sheet was formed by a number of coalescing ice dames from which ice flowed outwards. Material was eroded and deposited by the combined effect of ice mass movement and water contained within the ice. In west County Limerick and north County Kerry the dominant flow direction of ice was south-east. Evidence of these ice flow directions is provided by erratics of Galway granite found in County Limerick.

Generally glacial deposits in the region comprise till or boulder clay (with Devonian and Carboniferous sandstone and shale clasts). Over higher ground glacial till is thin or absent and bedrock is covered by a residual soil layer comprising highly weathered rock. The ice retreated from this region with little resultant sand and gravel deposition though an undulating terrain of sands, gravels and gravelly tills extends southwards from Shanagolden to the Newcastle West along the foot of the escarpment defining the junction between the Carboniferous limestones and the Namurian shales.

In post-glacial times there has been extensive deposition of alluvium along the major rivers including the Feale. On higher ground, bedrock is covered by an accumulation of blanket peat, which formed under conditions of high rainfall and humidity.

The dominant soil association comprises gley with associated acid brown earth and peat. The parent material for this soil is Upper Carboniferous shale dominated glacial till.

4.3. Hydrogeology

The Namurian sandstones and shales have a similar hydrogeological character throughout the region. The Namurian, though fractured, generally has a low permeability. Outcrop is mainly confined to higher ground and particularly where the rock is fine grained, water ingress is restricted. Most groundwater is confined to the upper weathered zone or zones where coarser sandstone beds are prominent. Based on GSI guidelines, the Namurian is classified as a poor aquifer generally unproductive except for in local zones.

The Visean limestones to the west of Newcastle West are muddy rather than argillaceous. Permeabilities in these rocks are dependent solely on the degree of fracturing created as a result of the Varican orogeny. There is little additional solution along fracture planes (karstification) that one would normally be associated with limestones hence the Visean is considered a "locally important" aquifer rather than a regionally important aquifer.

4.4. Potential Impacts on Geology and Hydrogeology

The proposed development will have little impact on geology or hydrogeology. The proposal will involve the clearing and levelling of soil and rock for road construction and turbine foundations.

The only potential impact to hydrogeology is the accidental release of oils or diesel to the subsurface during construction, thus impacting groundwater quality.

4.5. Mitigation Measures

Storage of diesel during the construction phase will be in steel or plastic tanks of good integrity and bunded to 110% of tank capacity. Any spills or leaks will therefore be contained.

The transformers used in the substation may be oil-cooled. These will be housed on bunded concrete pads. In the event of the leakage, any oil will be contained and cleaned up as part of regular maintenance.

5. HYDROLOGY

5.1. Hydrology in the Existing Environment

The main surface water body in the area is the Allaghaun River, which flows from east to west in a valley to the south of the site. The Allaghaun River is a tributary of the River Feale. Their confluence is just north of Abbeyfeale.

A number of streams rise in the proposed site and flow southwards. They merge together within a few hundred metres prior to joining the Allaghaun River approximately 1km to the south of the site. Surface water run-off is encouraged by the relative impermeable nature of the bedrock beneath the site, the high rainfall, steep southward dipping slopes and in places, the lack of quaternary cover.

The Allaghaun River is classified as unpolluted for its entire length except for where it passes Abbeyfeale. At this location it is classed as seriously polluted for a short length. This is based on water quality data published in the "EPA Water Quality in Ireland 1995-1997".

The aspects of the development relevant to hydrology are the contributions of site roads and turbine foundations to stormwater run-off.

5.2. Potential Impacts of the Development on Hydrology

The main hydrological impact of the development is an increase in runoff from a rain storm event. This would increase the peak flow to the streams draining the site. The possible increase in runoff results from a change in the surface runoff coefficient due to turbine foundations and road construction; however, the percentage change is insignificant as the following calculation shows: -

- new trackways will have a total length of 6.1km approximately at an average width of 4.5m.
  Total area = 2.7ha;

- a turbine foundation area including crane pad is 525m^2;
- for 17 turbines, this gives a total area of 0.9ha;
- the total catchment area subject to an increase in runoff coefficient is 3.6ha approximately; and
- the change in runoff coefficient will be an increase from 0.35 to 1.0.

For a rain storm event with a return period of 5 years, the intensity is estimated at 35mm/hr with a duration of 40 min. At present, this produces a total runoff of 6.3m^3/sec for the catchment of 184ha. The increased run-off from roads and hardstanding will be 0.2m^3/sec (or a 3.6% increase)

5.3. Mitigation Measures

The areas to be cleared for hardstanding and site trackways will account for approximately 2% of the total site area. The percentage increase in run-off will be relatively minor and it is noted that this increase will be taken up by a number of streams.

During the construction phase, best construction practices will be employed to minimise the release of sediment laden stormwater run-off. Trackways and turbines have been positioned at a minimum distance of 25m from the streams draining the site. Drainage swales will be constructed at road edges as necessary and culverted beneath trackways as appropriate using suitably sized pipework or span type structures as appropriate.

Sediment traps will be constructed as the construction of site tracks and hardstanding advances. These will be placed at locations to intercept run-off to streams.

Storage of oils and diesel on site will be in steel or plastic tanks of good integrity and bunded to 110% of tank capacity. These fuels will only be stored on site during the construction phase, which will be of relatively short duration.

6. CLIMATE

6.1. Climate in the Existing Environment

The long-term weather patterns at the site reflect regional conditions affecting the Munster area, dominated by low fronts from the west and south-west in winter months and more settled conditions during the summer months.

The nearest synoptic station to the site is located at Shannon Airport, approximately 38km to the north-east of the site. The grid co-ordinates for this station are R379 603.

The average annual precipitation of the area is 1,128mm as recorded at Abbeyfeale rain recording station. The average annual precipitation is 926mm for Shannon Airport.

The mean annual wind speed for the site is 8m/sec. The wind rose diagram for the site is provided in Figure 6.1.

6.2. Potential Impacts of the Development on Climate

The development of the wind farm will have positive impacts on the climate. Climate change has been identified as one of the most serious environmental problems facing Ireland at the present time (*Ireland's Environment-A Millennium Report*). The release of greenhouse gases such as CO_2 from the burning of fossil fuels is a known contributor to global warming. The avoided emissions of nitrogen oxides, sulphur dioxide and especially carbon dioxide using wind energy as a clean alternative energy source will have a positive impact on our climate.

The wind farm will have an installed electricity generating capacity of 26MW, which would otherwise be generated by carbon intensive technologies, likely fossil fuel burning power stations. There will therefore be a corresponding avoidance in emissions of greenhouse gases to the atmosphere. It is estimated that a 26MW wind farm corresponds to the following emission avoidance for a typical coal-fired generating plant.

CO_2

Reduction = $\frac{26 \times 0.37 \times 8760 \times 860}{1000}$

where 26 = the rated capacity of the wind farm (MW)
0.37 = a constant taking the intermittent nature of the wind, the availability of the wind turbines and array losses into account.
8760 = the number of hours in a year.
860 = the typical emission of CO_2 (in grams) per kilowatt hour in a coal fired plant.

Reduction = 72,473 tonnes

SO_2

Reduction = $\frac{26 \times 0.37 \times 8760 \times 10}{1000}$

where 26 = the rated capacity of the wind farm (MW)
0.37 = a constant taking the intermittent nature of the wind, the availability of the wind turbines and array losses into account.
8760 = the number of hours in a year.
10 = the typical emission of SO_2 (in grams) per kilowatt hour in a coal fired plant.

Reduction = 843 tonnes

NO_x

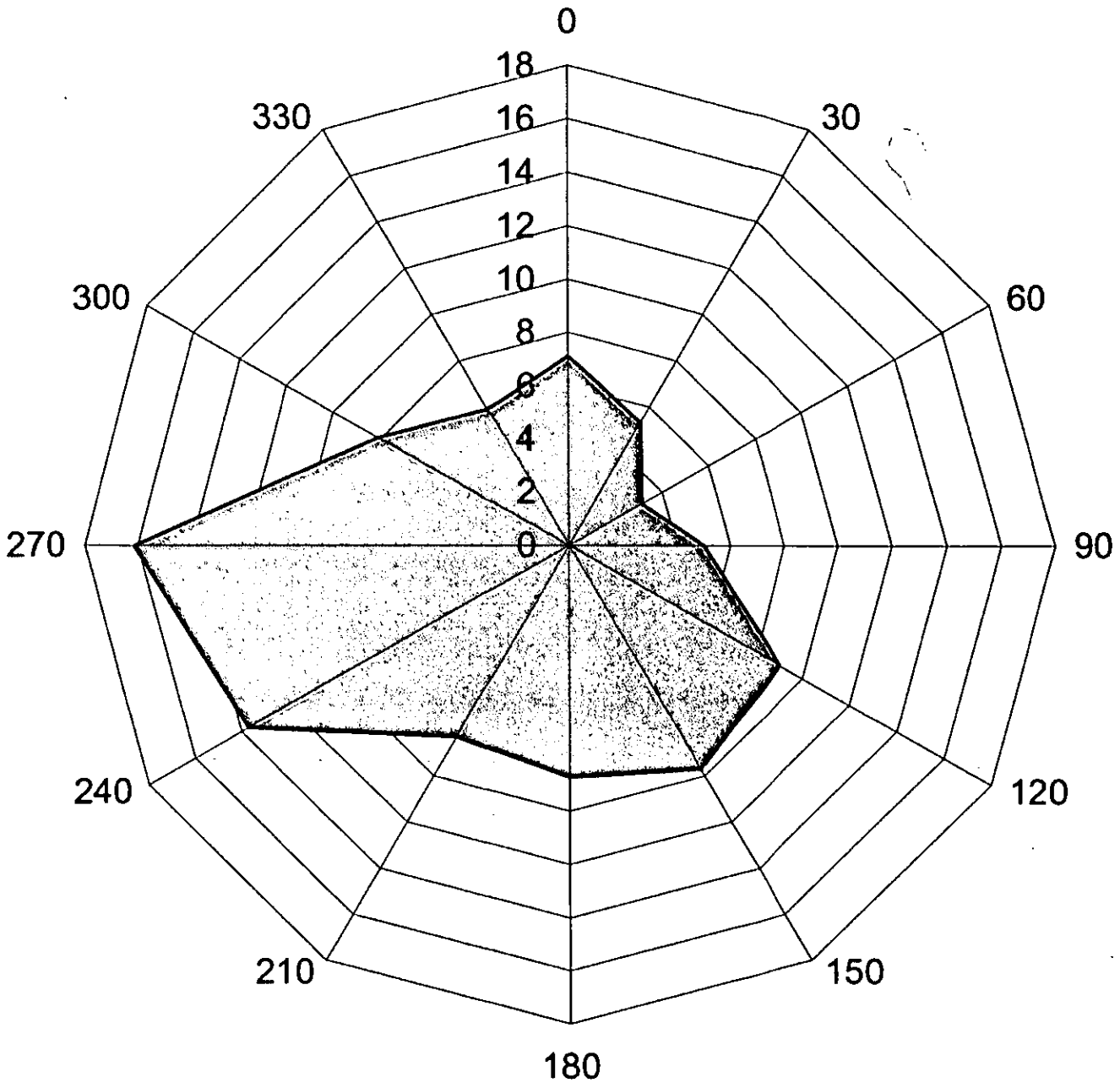
Reduction = $\frac{26 \times 0.37 \times 8760 \times 3}{1000}$

where 26 = the rated capacity of the wind farm (MW)
0.37 = a constant taking the intermittent nature of the wind, the availability of the wind turbines and array losses into account.
8760 = the number of hours in a year.
3 = the typical emission of NO_x (in grams) per kilowatt hour in a coal fired plant.

Reduction = 252 tonnes

6.3. Mitigation Measures

No mitigation measures are required.



Wind Rose Diagram
for Toornafulla Wind Farm
(Frequency in %)

7. CULTURAL HERITAGE

7.1. Cultural Heritage in the Existing Environment

A desk based archaeological assessment was undertaken in order to identify any archaeological constraints associated with the proposed development. The Duchas Archaeological Sites and Monuments Database and the 1999 Limerick County Development Plan were consulted to determine the locations of the nearest archaeological features.

There are only two recorded monuments or archaeological features within 1km of the site boundary. These are: -

- an excavated feature approximately 500m to the north east; and
- a graveyard at Templeglentan Church approximately 1km from the south-western site boundary.

The following is a list of archaeological features recorded within 5km of the site boundary: -

- 1 Burial ground;
- 3 Cashels;
- 1 Court- Tomb;
- 2 Enclosures;
- 1 Portal- Tomb;
- 5 Ring- Forts (Rath/ Cashel);
- 1 Souterrain;
- 2 Megalithic tombs; and
- 1 Linear feature.

The locations of these features are presented in Figure 7.1.

A number of buildings have also been listed for conservation. The closest such buildings to the site are;

Roman Catholic Church/Dissenter Meeting House

- Templeglentan
- Toornafulla

Medieval Churches, Castles and Abbeys

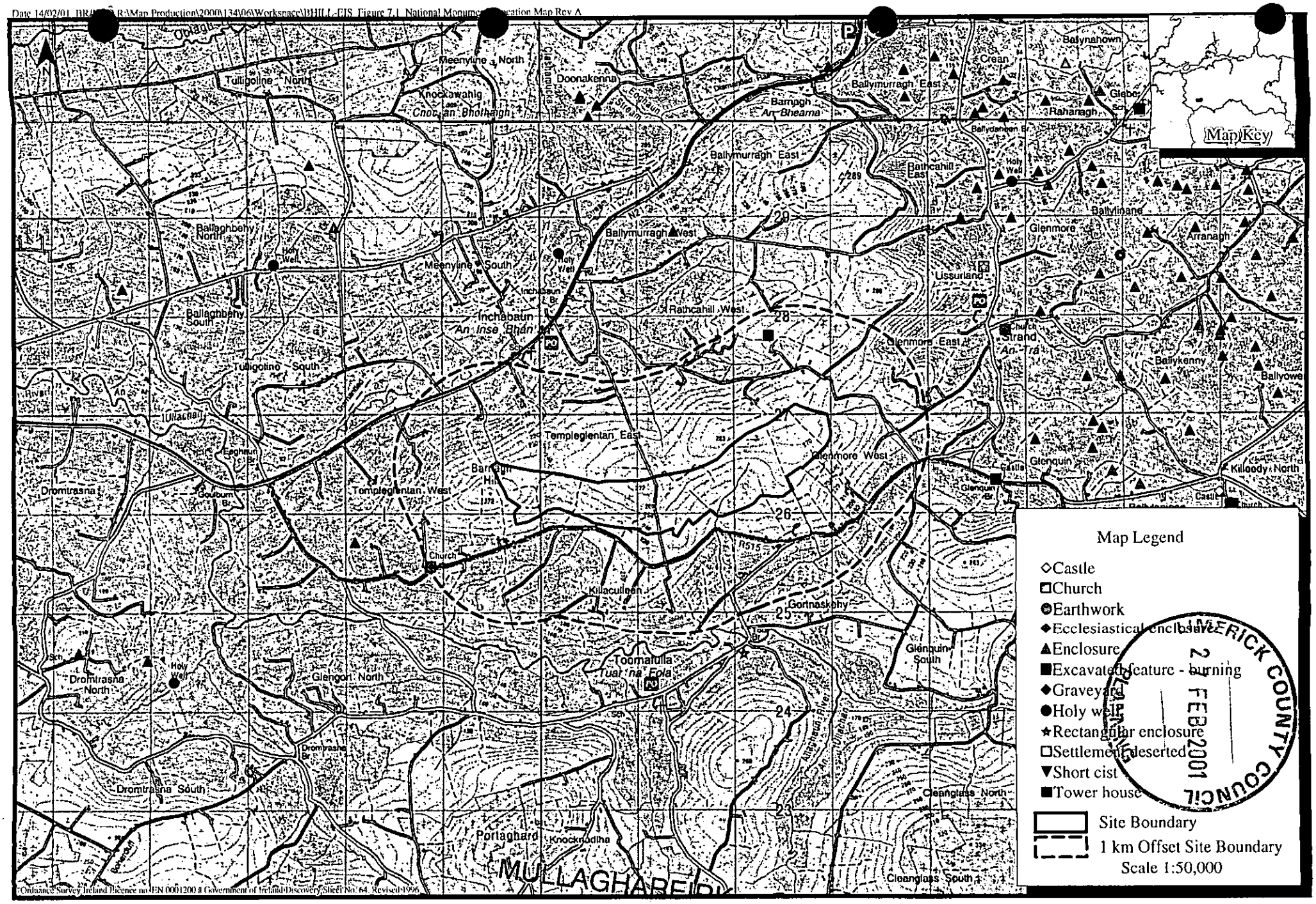
- Glenquin Castle

7.2. Potential Impacts of the Development on Cultural Heritage

It is not envisaged that the development will have any negative impacts on the cultural heritage of the area. The features identified will not be interfered with in any way during the construction or operation of the wind farm.

7.3. Mitigation Measures

Although no archaeological features have been recorded on the site to date, it is possible that unrecorded features are present. To mitigate against any potential impact during ground disturbance, the developer undertakes to commission a qualified archaeologist to monitor all earthworks. Any archaeological stratigraphy, features or artefacts uncovered during the course of this monitoring will be fully excavated and reported to Dúchas (The National Monument Service).



National Monuments Location Map

Fehily Timoney & Company

Figure 7.1

8. ECOLOGY

8.1. Ecology in the Existing Environment

An ecology survey was conducted at the proposed site for the wind farm on June 14th 2000. The purpose of the study was to survey the flora on site, identify the different habitat types present on site and to assess the suitability and impact of the proposed development on the ecology of the site and surrounding areas.

The ecological habitat on and around the site is shown on Figure 8.1. The site of interest covers an area of approximately 184ha with the highest elevation being 280mOD approximately. It is made up mainly of upland damp meadows, pasture and improved grassland areas.

The land surrounding the site is similar, consisting of agricultural grazing areas and some young coniferous plantations.

A number of streams rise along the south facing slope of the site, merging together within a few hundred metres prior to joining the Allaghaun River 1km to the south of the site. The Allaghaun River flows eastwards through Abbeyfeale where it merges with the Feale River.

The Allaghaun River is classified as unpolluted for its entire length except for where it passes Abbeyfeale where it is classed as seriously polluted for a short length.

The proposed site does not lie within a proposed Natural Heritage Area (pNHA) or a proposed Special Area of Conservation (pSAC)[32]. The locations of pNHAs and SACs in the general area are shown in Figure 8.2.

N

LEGEND

- RIVERS, STREAMS
- RECENTLY CUT VEGETATION
- MEADOW AREA
- CONIFEROUS FORESTRY
- PASTURELAND
- SMALLER MORE ENCLOSED FIELDS

REVISION A — FEB. 2001

ED/DK — 2000/134/06/bhill-eis_fig81

LIMERICK OS Sheet Nos. 43,43a,53,53a

FEHILY TIMONEY & COMPANY

1:10560 SITE HABITATS PLAN

FIGURE 8.1

REVISION B

ED/DK

FEB. 2001

2000/134/06/bhill-eis_fig82

SITE LOCATION

Heritage Service
Seirbhís Oidhreachta
National Parks & Wildlife
Páirceanna Náisiúnta & an Fiadhúlra

Chomh-mhaoinithe trí chiste 'LIFE' an A.E.
Co-financed through 'LIFE' E.U. funding

PROPOSED NATURAL HERITAGE AREAS (pNHA) and
PROPOSED CANDIDATE SPECIAL AREA OF CONSERVATION (pCSAC)
CEANTAIR OIDHREACHTA NÁDÚRTHA - MOLTA agus
CEANTAIR SPESIALTA CAOMHNAITHE - MOLTA

Féaltar athruithe a chur an na ceantair / Sites subject to revision
(ní thaispeántar astúnh gur de spéis géolaíoch amháin iad.) / (Sites solely of geological interest not shown.)
Mapcomhrall d'ábhar na Suirbhéireachta Ordonáis le cead ón Rialtas (Creidiúnas Uimh. 5958)

pCSAC

CO. LUIMNIGH
CO. LIMERICK

0 10km
Scale: Half-Inch=1 Mile 1:126,720

N

Céad Céim
First Phase

55

21/05/1997

FEHILY TIMONEY & COMPANY

NHA & SAC IN SITE VICINITY

FIGURE 8.2

8.1.1. Flora

Plant species on the site were identified using the following keys:

- *The Wild Flower Key: British Isles – N.W. Europe*
  Francis Rose
  1981

- *Collins Pocket Guide: Grasses, Sedges, Rushes & Ferns of Britain and Northern Europe*
  R. Fitter, A. Fitter and A. Farrer
  1992

- *Collins Guide to the Ferns, Mosses and Lichens*
  Hans Martin Johns
  1980

The main habitat type on the site is damp pastureland, dominated by grasses. Cattle graze these areas. There are also fields within the site, which are not grazed at present, and the grass has grown up to over one metre. Buttercup and dock species are also very common in these meadow areas with rushes occurring occasionally in the damper patches.

Both deciduous and coniferous trees define the various hedgerows throughout the site with dock, foxglove and oxeye daisy also abundant in these areas.

Various grass species and ferns dominate the verges of the road dissecting the site. Other common species include bramble, white clover, red clover, buttercup, dandelion, gorse, daisy, nettle, ribwort, common mouse-ear, brookline, water dropwort and various mosses and sedges.

There is one area of coniferous forestry within the site.

8.1.2. Potential Impacts on Flora

The only impact on flora will be as a result of land take for the development and this will be minimal. This will include 17 areas of hardstanding surrounding the turbines and substation and the tracks through the site. The remainder of the site will not be disturbed. The pastureland vegetation will remain intact and it is not expected that species diversity will be affected. These habitats are strongly influenced by the farming activity at present and the additional activities associated with the wind farm will not further impact these habitats to any significant degree.

There will be no pollutants emitted to air, land or water during the normal operational phase of this development. Transformers and capacitors will be oil-cooled and if they fail, oils could leak. They are however located in contained areas and therefore there is minimal risk to the existing habitat due to spills or leaks.

During the construction phase, diesel will be stored on site in a 1,000-litre bunded storage tank.

8.1.3. Mitigation Measures

The majority of the pastureland habitat on the site is to be left intact and undisturbed.

Construction activities will be managed so that off-track vehicle use will be avoided thereby minimising disturbance.

On decommissioning of the wind farm, the site will be restored to pastureland.

8.2. Mammals

Although no mammals were positively identified during this survey, it is likely that species such as rabbit, hare, fox, shrew, rat and woodmouse utilise the site. Such mammals may use the site for feeding purposes with the smaller species using the hedgerows of the site for shelter and travel routes.

The coniferous plantation provides shelter and wildlife corridors for the mammals.

8.2.1. Potential Impacts on Mammals

It is not expected that the development will have a significant impact on mammals. It is possible that during construction, with increased activity on the site, mammals may be temporarily diverted from using the site. However, most small mammals are nocturnal and so would not be significantly affected by daytime activities.

It is unlikely that the development will have a significant negative impact on the travel path of small mammals using the site.

8.2.2. Mitigation Measures

Apart from the areas of hardstanding on the site (around the turbines, site roads and substation) the habitat/vegetation of the site will not be changed. Most of the foraging areas utilised by small mammals will therefore remain intact. The site can continue to be used for agricultural purposes.

8.3. Birds

Aquatic Services Unit (ASU)-UCC were commissioned to carry out a bird impact survey for the proposed wind farm.

8.3.1. Methodology

The site was visited twice, on the 25th and 29th November 2000, in order to survey the bird populations using the site and the surrounding area, and in order to assess the importance of the habitats present in the area for birds.

Weather conditions on 25th November were as follows: temperature, approximately 5 to 8°C; wind, SSW, force 4-6; cloud cover, 8/8; occasional heavy squally showers; visibility, good, moderate or poor in showers. On 29th November, temperature was approximately 8 to 10°C; wind was WSW, force 5-7; cloud cover was 8/8; visibility was good, with intermittent rain.

The site was surveyed on foot, in the form of a series of belt-transects. Each transect was walked slowly, and all birds seen or heard within 30m either side of the observer were noted. A total of 5 such transects were walked, totalling approximately 3,000m in length, hence covering a total area of approximately 18ha (approximately 10% of the site). Throughout both visits, regular scans were made with binoculars. All areas of the site were visited and the different habitat types present were examined and mapped.

The context of the site and its immediate surroundings within a broader area was assessed by walking and driving roads within 5 to 10km of the site, stopping regularly and scanning with binoculars.

It is important to note that any bird survey carried out over two days, in late Autumn will not provide a full picture of the bird populations using the site. November is not the best season for an assessment of the importance of an upland site.

Many species that breed in uplands in Spring and Summer move to lower altitudes outside the breeding season. Resident species become less conspicuous outside the breeding season.

8.3.2. Results

Table 8.1 Numbers of Birds Recorded and Corresponding Calculated Densities

Species	Transect Number					Number Recorded	Density / km ^{2}
	1	2	3	4	5		
Pheasant			1			1	0.18
Meadow Pipit	2	27	4		1	34	6.12
Fieldfare	22					22	3.96
Song Thrush		1			2	3	0.54
Wren				1		1	0.18
Robin					1	1	.18
Stonechat					1	1	.18
Rook	14				24	24	4.32
Jackdaw					11	11	1.98
Starling	80					80	14.4

Table 8.2 Total Number of Individual Birds of Each Species Recorded on the Site

Species	Number Recorded 25th November	Number Recorded 29th November	Total Number Recorded
Merlin		1	1
Snipe	2	2	4
Pheasant		1	1
Meadow Pipit	33	49	82
Wren	5	8	13
Robin		1	1
Stonechat	2	3	5
Song Thrush	2	4	6
Blackbird		2	2
Redwing	31	11	42
Fieldfare	44	49	93
Jackdaw	31	24	55
Rook	56	38	94
Blue Tit		1	1
Starling	160	300	460
Chaffinch		1	1

Numbers and diversity of birds recorded at the site were probably rather lower than would be expected due to adverse weather conditions during both visits. A total of 16 species were recorded on the site. The most abundant species were Starling, Rook and Fieldfare, flocks of which were feeding on open pasture, mainly in the eastern portion of the site, along with smaller numbers of Redwing and Jackdaw. These are all widespread and common species in Ireland during the winter months. Large numbers of Meadow Pipit were also recorded. This is an abundant species, found in open habitats throughout Ireland.

A Merlin, seen hunting in the north-east of the site on 29th November was the only bird of prey recorded and was the only species of conservation interest seen (Merlin was classified as 'rare' by Whilde 1993).

Small numbers of common resident passerines such as Stonechat, Song Thrush, Blackbird and Wren were recorded wherever suitable cover occurred such as along hedgerows and ditches. The birds recorded at the site represent a typical winter bird community for this type of rough grassland habitat.

Other species, which might be expected to use this habitat outside the breeding season, include waders (only two snipe were recorded during the field visits) such as Curlew, Lapwing and Golden Plover and birds of prey such as Peregrine and Hen Harrier.

During the breeding season, the habitats of the site would be of rather limited value to birds. Skylark, Meadow Pipit and small numbers of Snipe probably breed on some of the rougher grassland. Some common passerine species such as Wren, Robin, Stonechat, Blackbird, Chaffinch and Reed Bunting probably breed in small numbers along the ditches, hedges and shelter-breaks. Larger numbers and a greater diversity of species may nest in the area of small fields in the centre of the site, but a breeding season survey would be required to confirm this.

There appears to be a fairly high level of grazing over most of the area, and there are several farms in the near vicinity, so it appears likely that levels of human disturbance are also quite high. Although the habitat is probably suitable for Curlew to breed, these disturbance factors make it unlikely that they do.

8.3.3. Discussion

No specific detailed data on the bird populations of the site are known, but two general 'atlas' studies provide data on the species breeding or possibly breeding within the 10km-grid squares in which the site is located, and thus give important data on the bird populations of the area.

The site lies on the boundary of two 10km-grid squares, R12 and R22. During the first atlas survey (Sharrock 1976[33]), for which the fieldwork was carried-out from 1968 to 1972, four species of high conservation value were recorded within 10km of the site. Merlin possibly bred in R22, with confirmed breeding 10 to 20km away in R02 and R04. Red Grouse was widespread in the area, with confirmed breeding in R22. Curlew was confirmed breeding in R12 and probably bred in R22. Hen Harrier was found probably breeding in R12 and possibly breeding in R22.

By the time of the second atlas survey (Gibbons et al. 1993[34]), carried out in 1988-91, the ranges of three of these had declined greatly in this area, as they had over much of their respective ranges throughout Ireland. No Merlin were recorded in either square, with the nearest confirmed breeding of Merlin in R00, 20 to 30km away and Red Grouse in R13, 10 to 20km to the north-west. Curlew was again confirmed breeding in R12. Hen Harrier was present in both R12 and R22, but breeding was not confirmed in either.

The uplands in this area, including the Mullaghareirk and Glanaruddery mountains are a traditional population centre for Hen Harrier. They are one of the few areas in Ireland where little or no range contraction occurred between the two atlas surveys, remaining a stronghold for the species (Gibbons et al. 1993). A national survey of Hen Harriers is currently underway, being organised jointly by the Irish Raptor Study Group (IRSG), BirdWatch Ireland (BWI) and Dúchas-National Parks and Wildlife Survey (NPW). Preliminary results confirm that the species is still present in the Mullaghareirk Mountains (Norriss 1999).

No major concentrations of wildfowl are known to occur in the area, and there is no evidence that numbers of wildfowl migrate through the site (Delany 1997[35]; Colhoun 2000[36]).

The open areas of this site probably hold a breeding bird community typical of such open upland habitats, with Meadow Pipit, Skylark and probably smaller numbers of Snipe breeding. The ditches, hedges and shelter-belts probably hold small numbers of common songbirds such as Wren, Robin, Stonechat, Blackbird, Chaffinch and Reed Bunting. It is unlikely that any species of conservation value breed on, or close to, the site. Although published data indicates that Hen Harriers are present in the Mullaghareirks during the breeding season, there is no suitable breeding habitat on or close to the survey site.

Outside the breeding season, the site provides suitable feeding habitat for high densities of species, which utilise such open grassland habitats such as Golden Plover, Fieldfare and Redwing. The presence of these may attract birds of prey such as Peregrine and Hen Harrier to the area. This said, the habitats present are typical of large areas of Ireland and are hence not of major conservation value.

8.3.4. Potential Impacts on Birds

There are two potential types of impact to be considered:

- disturbance, and habitat damage or loss – during the construction/installation phase, during site maintenance visits, and ongoing aural/visual disturbance of the structures themselves.

- collision – collision with turbines or associated structures (including any of the aboveground power lines leading away from the site).

Disturbance, habitat loss and habitat damage may be a more important potential impact on birds than actual collisions at upland sites such as this (BirdWatch Ireland 1998). The most serious potential impact is on scarce species breeding at or near the site. Evidence of long-term impacts is however not well understood (Lowther 1998[37]), and further work is needed on a national scale.

Collisions can occur at turbines, or at associated masts, pylons, cables and power lines.

The potential impact of collisions on bird populations, in conservation terms, is perhaps most serious in the case of rare birds of prey; where the loss of breeding adults may be highly significant. At a local or regional level, the loss of even one single such bird may be important. Data from California indicate that although collisions at wind farms are generally few, birds of prey usually form a high proportion (65-70%) of casualties (California Energy Commission 1995[38]). This work may however, not be directly relevant in an Irish context, as raptor populations here are lower (particularly large raptors, which tend to be most at risk) and turbine densities are also generally lower. Hence, the risk of collision in Ireland is likely to be lower than in the US studies. This said, there remains potential for rare birds of prey such as Hen Harrier to collide with turbines and associated structures.

Note: These Californian statistics refer to lattice type towers, which allow birds to perch and nest on them. The towers planned for this development are solid tubular towers. There will be no area for birds to land.

Potential for collision in terms of actual numbers of birds is probably highest during Spring and Autumn migration periods, or in situations where large numbers of birds pass through a site on a daily basis, for example moving between feeding and roosting sites. There is, however, no evidence to suggest that large numbers of birds regularly fly over this site. Swans, due to their size and lack of manoeuvrability are particularly vulnerable to collision. There are no lakes in the vicinity of the site which hold large numbers of waterfowl, and no major concentrations of Swans are known to occur in the area (Delaney 1997).

Taking into account the location and nature of the proposed development experience at wind farm developments in other countries, available published information on bird populations in the area and the site visits, there is no evidence to indicate that this development will have any significant impact on birds. On a precautionary basis, consideration should be given to avoidance, remedial or reductive measures and to monitoring.

It is difficult to assess accurately the bird populations of a site based on only two winter visits. This said, however, the evidence from the field surveys and from published data suggest that the site is not of great importance to breeding birds, and that no species of high conservation value are likely to breed there. The site holds good numbers of common non-breeding species, which may be vulnerable to disturbance and collision. The suggested mitigation measures should help to lessen the impact of the development.

8.3.5. Mitigation Measures

The following measures will be undertaken in order to minimise the impact on bird populations using the site throughout the year: -

- the disturbance of breeding birds during construction will be avoided where possible by minimising the works conducted between April and June. This will be balanced with the advantage of working in dry conditions to minimise soil erosion and habitat damage;
- existing tracks will be used or improved where possible to reduce habitat damage, although at this site the opportunity for this is limited;
- site maintenance visits will be kept as brief as possible; and
- continued monitoring of avian usage of the site will be carried out, during and after installation.

9. LANDSCAPE AND VISUAL IMPACT

9.1. Introduction

This section describes the existing landscape and visual character of the site and its surrounds and the potential impact the development could have thereon. The description of the area is based on survey and analysis carried out on site. Information regarding the vegetation in the locality is derived from field observations and the ecologist's report.

The term landscape refers primarily to the visual appearance of the land, including shape, form and colour, and their interaction to create specific patterns and pictures that are distinctive to particular localities. However, the landscape is not purely a visual phenomenon because its character relies closely on its physiography and its history. Hence, in addition to the scenic and/or visual dimension, there are a whole range of other dimensions, including geology, topography, soils, ecology, archaeology, landscape history, land use, buildings and settlement, architecture, cultural associations and human beings.

This section deals with the above in so far as they may determine the Landscape and Visual Characteristics of the locality, and on which the proposed development may have environmental effects.

9.2. The Existing Landscape

A general description of the landscape encompassing the immediate context of the proposed wind farm site is provided below under the headings of landform, vegetation and structures. Additional descriptions of the landscape as viewed from each selected viewpoint are provided under the detailed assessments in Section 9.5.6.2, using a similar structure.

9.2.1. Landform

The site lies on a moderate southern-facing slope immediately to the east of Barnagh Hill. Barnagh Hill is part of the foothills of Mullaghereirk Mountains and runs in an east to west direction. The surrounding area consists of low-lying landscape to the east and west which gives rise to high visibility of the site. Elevated areas lie to the north and south of the site. The Mullaghereirk Mountains extend to within 2km of Barnagh Hill and are separated by the Allaghaun River Valley. Sugar Hill lies to the north of the site and extends to the north of Newcastle West.

9.2.2. Vegetation and Land Use

The vegetation consists mainly of upland damp meadows, pasture areas and improved grassland areas. The lands are used for pasture.

The character of the surrounding area is mostly made up of agriculture with some forestry plantations in areas of higher elevation particularly on the higher grounds around Sugar Hill and the Mullaghereirk Mountains.

9.2.3. Structures

Structures throughout this area are discussed in outline under the following headings:

- urban Centres and Housing;
- communication routes; and
- utilities.

Urban Centres and Housing

There are a large number of dwellings in the vicinity of the site and consist mainly of farmsteads, and ribbon development along the roads near the site. The villages of Toomafulla and Templeglentan are approximately 2km to the south and north respectively. The nearest towns are Abbeyfeale and Newcastle West approximately 7 and 9km to the west and east respectively.

Fifty residential properties fall within 1000m of the nearest turbines.

Communication Routes

Communication routes are listed below;-

- National primary road
  -N21
- Regional roads
  -R515
- Third class roads
  -An extensive network of county roads traverse the area
- Other roads
  -Some isolated farmsteads are serviced by 'other roads'
- Railway Line
  -A disused/dismantled rail way runs parallel to the N21, on the north side of the road

The N21 is located less than 2km from the northern boundary and runs in a north-east to south-west direction, linking Newcastle West and Castle Island in County Kerry. The R515 to the south is approximately 500m from the nearest turbines and runs in an east-west direction. A number of third class roads link the N21 and R515. Other roads connect private housing and isolated farmsteads.

Utilities

Electrical and telegraph poles flank many of the roads, servicing the houses in the area. High voltage power lines, originating in Tarbert, run in a general north to south direction to the west of Abbeyfeale. A number of communication masts are located in the higher ground in the vicinity of the site. These include a mast on Knockanimpuha, near Sugar Hill and one just to the south of Barnagh Gap.

9.3. Scope of Impacts

The proposals will inevitably impact on the landscape and visual character of the surrounding areas. The perception of this impact will be subjective depending on one's opinion of renewable energy. Changes will arise primarily from:

- the construction of 17 wind turbines of hub height 65m;

- the construction of the substation; and
- the construction of site tracks.

and these changes will impact primarily from:

- residences, and
- roads.

9.4. Impact Assessment

The scope of this assessment took the form of:

- site visits;
- desktop studies;
- identification of the impacting features of the development;
- mapping zones of visual influence in a 17km x 17km area around the site;
- creating wire frame views of the site from a number of viewpoints in the landscape; and
- photomontages of some of these viewpoints.

Visual impact may occur by means of intrusion and/or obstruction where these terms are defined as follows:

- **Visual Intrusion:** Impact on view without blocking, and
- **Visual Obstruction:** Impact on view involving blocking thereof.

Visual impacts by means of intrusion or obstruction on a particular view may be viewed as positive, neutral or negative and can be rated as follows:

- **Little/None** arises where the proposal is adequately screened by existing landform, vegetation or built environment.
- **Low** arises where views affected by the proposal form only a small element in the overall panorama.

- **Moderate** arises where an appreciable segment of the panorama is affected or where there is an intrusion into the foreground.

- **High** arises where the view is significantly affected, obstructed or so dominated by the proposal as to form the form the focus of attention.

9.4.1. Site Visits

A number of site visits were conducted between September 2000 and February 2001 to visually evaluate the site and its surrounds, determine the visibility of the site from a number of viewpoints in the landscape and identify the location and number of residences in the vicinity of the site which may have visual impacts.

9.4.2. Desk Study

A desktop study was undertaken to review the contents of the *1999 Limerick County Development Plan* and to determine it relevance to the development. There are a number of views and prospects of scenic importance in the vicinity of the site. These are listed as follows:

- Sugar Hill, located to the north-east of Newcastle West;
- Mullaghareirk Mountains, located to the south-east of the site; and
- views at Barnagh gap.

The main route from Limerick to Abbeyfeale (N21) passes just north of the site. This is one of the main tourist routes in the area. There are no scenic routes in the vicinity of the site.

The site location is not listed under any natural heritage areas, special protection areas or special areas of conservation as outlined in the County Development Plan. The County Development Plan lists a number of buildings for conservation. These are discussed in Section 7. The proposed development will not impact on the listed buildings for preservation.

9.4.3. Impacting Features of the Development.

To be commercially viable, wind farms must be located in exposed areas making them visible. This visibility is very subjective and wind farms can either be seen as a clean approach to energy generation or an unwelcome intrusion to the landscape.

Turbines

The physical presence of turbines and the movement of blades will give rise to the greatest change in the environment. By nature of their function, wind turbines will be very visible elements in the landscape, as they must be sited to harness the power of the wind.

It is proposed to construct 17 turbines at the site. These turbines will be of hub height 65m and blade diameter of 70m. Turbines will be arranged in a linear pattern to maximise contact with the wind and will follow the natural topography of the land. Turbines will be finished an off white/grey colour so they will blend in with the landscape against a backdrop of sky. They will also be finished to a matt finish to reduce surface reflection.

It is during clear blue-sky conditions that the turbines are most visible from distant views. Observations made at other wind farms indicate that the turbines become difficult to see in cloudy conditions and are visually unobtrusive.

9.4.4. Site Infrastructure

In addition to the installation of 17 turbines, the development will consist of a wind monitoring mast, substation and internal site tracks. This infrastructure, because of their size will only be visible from near views.

The meteorological monitoring mast will be of lattice tower construction 50m high. The meteorological mast will be visible from a number of nearby roads and residences. Because of its lattice construction there will be no medium or distant views.

The substation will be constructed to ESB specifications and will consist of a control room and fenced in compound to house electrical equipment. The fence will be 2m high. This is required for health and safety purposes. It has been position on the west side of the site near an existing ditch to providing screening. This structure will only be seen from near views.

To screen the tracks, a screening berm will be constructed using the excavated soil. The berm will be placed along the down slope side of the tracks and allowed to vegetate naturally. Excess soil will be spread and levelled adjacent to the tracks. Once vegetated, site tracks will only be visible from near views.

9.4.5. Nature and Extent of Visibility

Zone of visual influence (ZVIs) maps are computer generated and are used to assess where turbines are theoretically visible in the landscape.

The map indicates areas where turbines are theoretically visible and represents a worst case scenario for visual impact as it only considers topographic data at 50m grid spacing and does not take into account vegetation and small scale topographic screening. There is scope for screening and filtering views from points within the wider landscape as a result of intervening features such as woodland, hedgerows and topographic features less than 10m in height. Roads and tracks, which fall within the ZVI, can also be well screened by hedges, other vegetation and local topography, which reduce the viewing opportunity.

A ZVI map was constructed from a 17 by 17km area around the site. Visibility was measured at blade tip, which would be the highest point of the turbine, which could potentially be viewed.

However with increasing distance and depending on the wind direction and hence on the orientation of the blades relative to the viewing location, the blade tips may not be seen. Four colour schemes were used to represent areas of varying visibility around the site.

- Yellow 1-4 turbines visible
- Blue 5-8 turbines visible
- Pink 9-12 turbines visible
- Red 13-17 turbines visible

The potential visibility of the wind farm is highest along the southern slopes of Sugar Hill between Abbeyfeale and Barnagh Gap and along the northern slopes on the Mullaghareirk Mountains. These will be the closest viewing locations of the wind farm i.e. within 5km. Areas sheltered by these mountains will not be impacted by the development. More distant views of the site are available from locations to the north of the Oolagh River and in the low lying plains to the east of the site.

The site will be visible from the N21 between Abbeyfeale and a point just west of Barnagh Gap. Four viewpoints were taken from the N21 to illustrate the degree of visibility. The highest degree of visibility occurs along a 3km stretch of the N21 to the east of Abbeyfeale, and along a 1km section just east of Inchabaun.

Approximately 4km from the site near Goulburn Bridge along the N21, the visibility of the wind farm is low as Barnagh Hill screens views of the turbines. This is demonstrated in Viewpoint No. 2. This lower visibility extends to Templeglentan village as far as the post office. A viewpoint was also taken at Templeglentan School (Viewpoint No. 3).

At Ballymurragh East there are clear views of the site as demonstrated in Viewpoint No.4. Beyond Ballymurragh East, there are no views of the wind farm. There are no views at Barnagh Gap. This is a listed view and prospects area. The view from Barnagh Hill is towards Newcastle West (opposite direction to the site). Sugar Hill is a listed views and prospects area also. There will be clear views of the site from this area (Viewpoint No. 5).

On the outskirts of Newcastle West, visibility is low. Considering also the distance from the site, the impact of the wind farm from Newcastle West will be very low.

The village most impacted is Toornafulla. There is widespread local visibility of the site as the turbines are sited along the southern slope of the hill overlooking the village. The nature and extent of the visibility is represented in Viewpoint No. 6 taken from the church.

The R515 will also be impacted from Glenquin as far as the intersection with the N21 near Goulburn Bridge. A number of other roads will also be impacted but these are less travelled.

The perception of a wind farm in the landscape depends on the distance between the observer and the turbines (Stanton, 1996[39]). A number of viewpoints have been selected from which the extent and nature of the turbine visibility can be evaluated. These are presented in photomontage and wire frame view formats taken at various distances from the site.

Up to 2km from the site, turbines are significant visible elements in the landscape. This is because the elevated terrain on which the wind farm is sited, and the close range views of the turbines at 65m-hub height, is a dominant focal point in the landscape.

Between 2km and 5km they tend to be seen as just one aspect of many within the landscape.

Up to 5km, the turbines are becoming less visually obtrusive with distance and are integrated to a greater extent with the background landscape, the landscape width expanding with greater distance from the site.

Within the 5-10km radius around the site, the wind farm is seen as one unit in a wide field of view.

From distances greater than 10km and up to 20km from the site, the visibility of the turbines decreases significantly. At these distances, the blades are very difficult to see due to their movement.

Viewpoints are typically selected from areas where the proposed wind farm may significantly impact on the visual amenity of the area. The viewpoints selected are as follows: -

- viewpoint 1 on the N21 outside Abbeyfeale;
- viewpoint 2 on the N21 near Goulburn Bridge;
- viewpoint 3 at Templeglentan School;
- viewpoint 4 at Ballymurragh East;
- viewpoint 5 at Sugar Hill; and
- viewpoint 6 outside Toornafulla church.

The viewpoint locations are shown on the ZVI (Figure 9.1). The photomontages are provided as Figures 9.2 to Figure 9.7 for Viewpoints 1 to 6 respectively.

REVISION A — November 2000

SK/OH — 2000/134/06/bhill-eis_fig91

13 -> 17 Turbines Visible

9 -> 12 Turbines Visible

5 -> 8 Turbines Visible

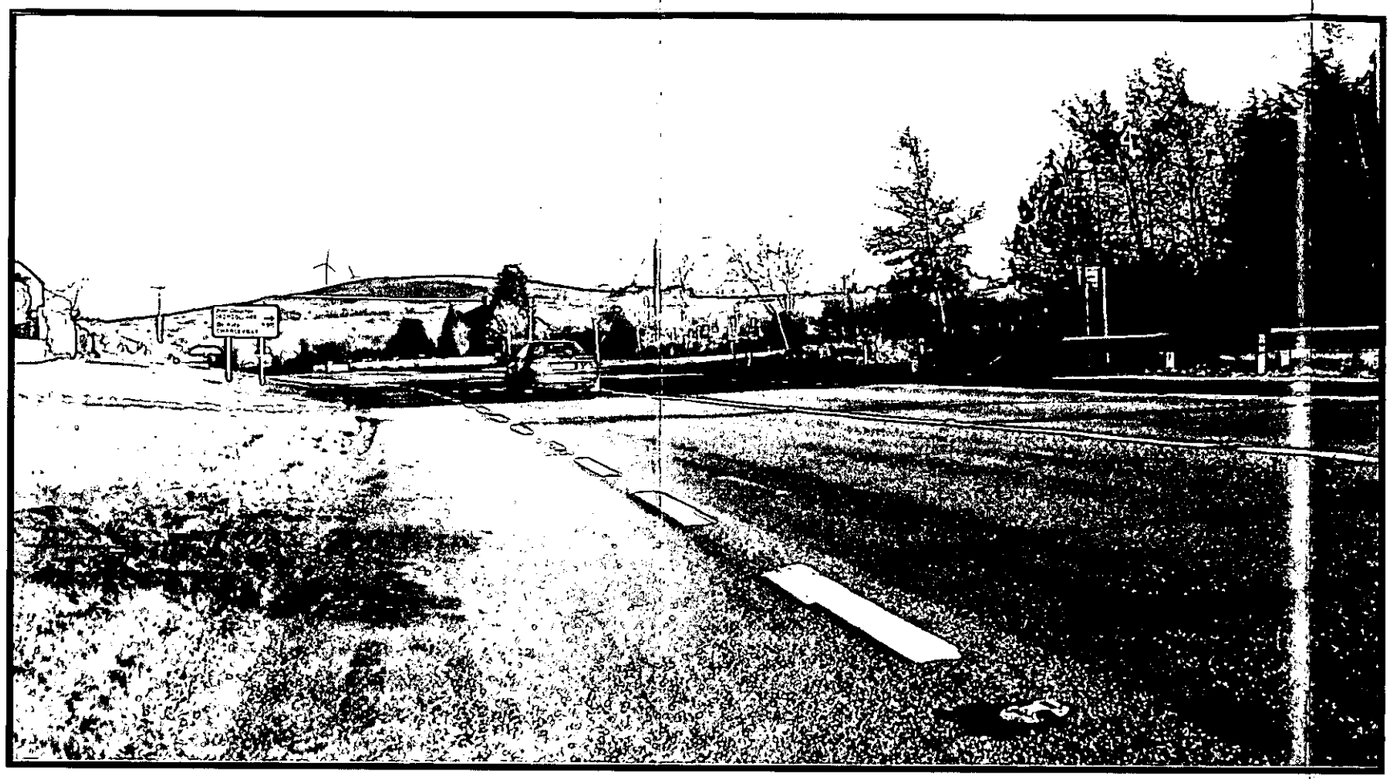
1 -> 4 Turbines Visible

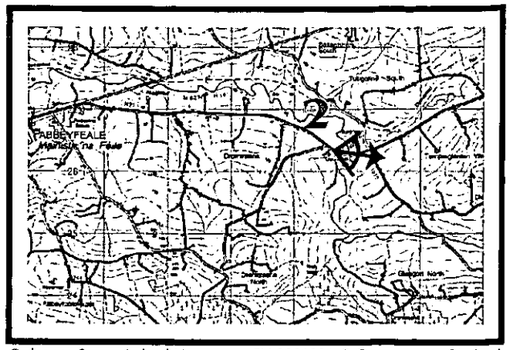
The ZVI represents the worst case scenario in terms of viewing exposure.It is generated using digital terrain data at 10m contour intervals. It does not take account of local topographical features less than 10m in height or screening provided by hedgerows, buildings etc..

FIGURE 9.1

Fehily Timoney & Company

1:60,000 ZONES OF VISUAL INFLUENCE (Hub Height 65m)
Showing View Point Locations





Ordnance Survey Ireland Licence no. EN 0001201 © Government of Ireland

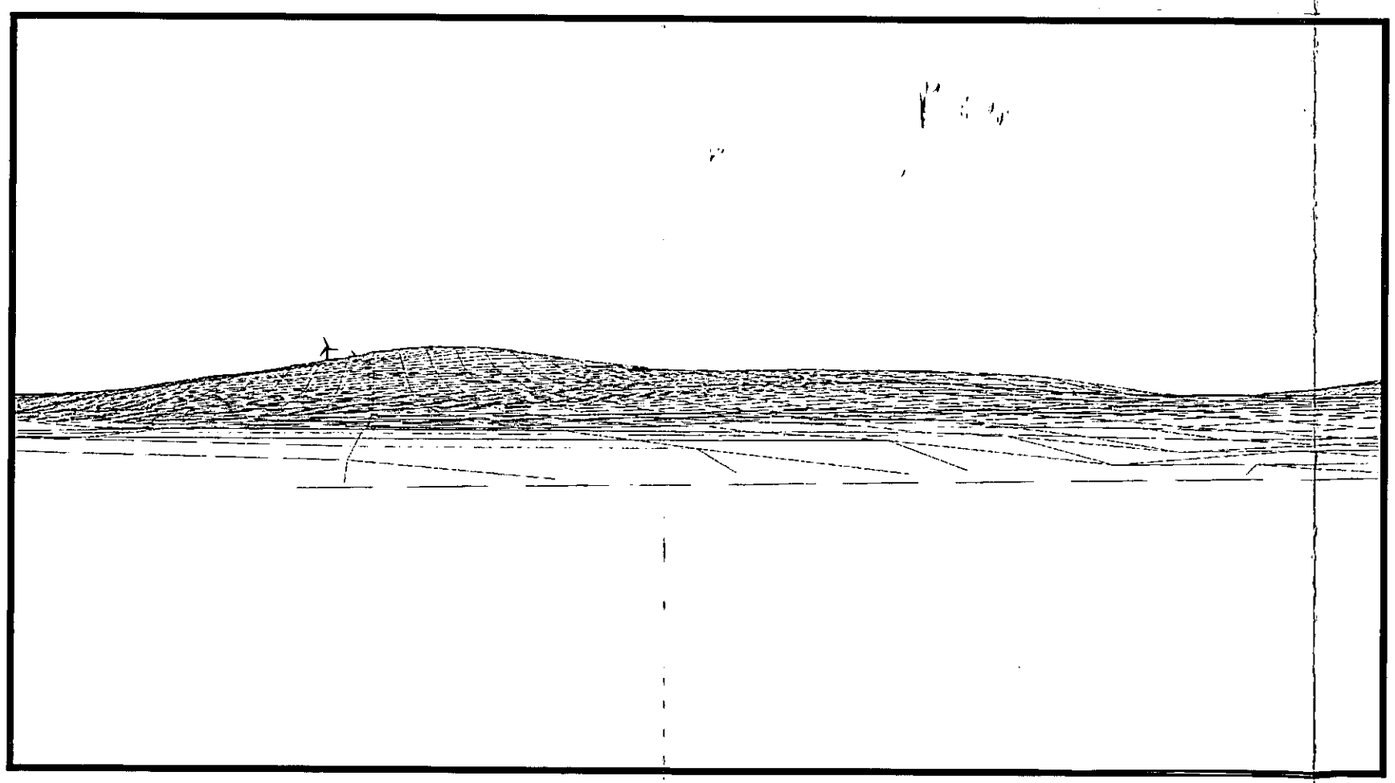
Notes:
Tip height = 100m
Included Angle = 57°
Camera height = 1.8m
Pitch Angle = -1.2°

Grid reference:116601 E, 126347 N
Distance: 3.13km (To nearest turbine)
Elevation: 88m
Number of tips visible: - 6
Number of hubs visible: - 2

Revision A - Issue for Planning Application
Date of Issue -February 2001
Photomontage and Wireframe
Prepared by
Fehily Timoney and Company,
Core House,
Pouladuff Road, Cork

FEHILY TIMONEY & COMPANY

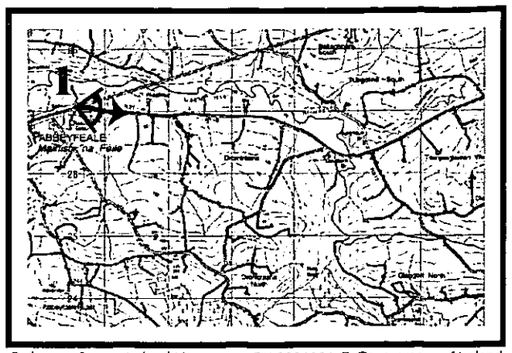
DK/SK
2000/134/06/bhill-eis_fig93



VIEW No. 2
From
Goldburn Bridge

PLANNING APPLICATION
FOR A PROPOSED WIND FARM SITE
AT TOORNAFULLA, Co. LIMERICK

FIGURE 9.3



Notes:
Tip height = 100m
Included Angle = 55°
Camera height = 1.8m
Pitch Angle = -0.8°

Grid reference:112800 E, 127079 N
Distance: 6.96km (To nearest turbine)
Elevation: 83m
Number of tips visible: - 16
Number of hubs visible: - 13

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Prepared by
Fehily Timoney and Company,
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FEHILY TIMONEY & COMPANY

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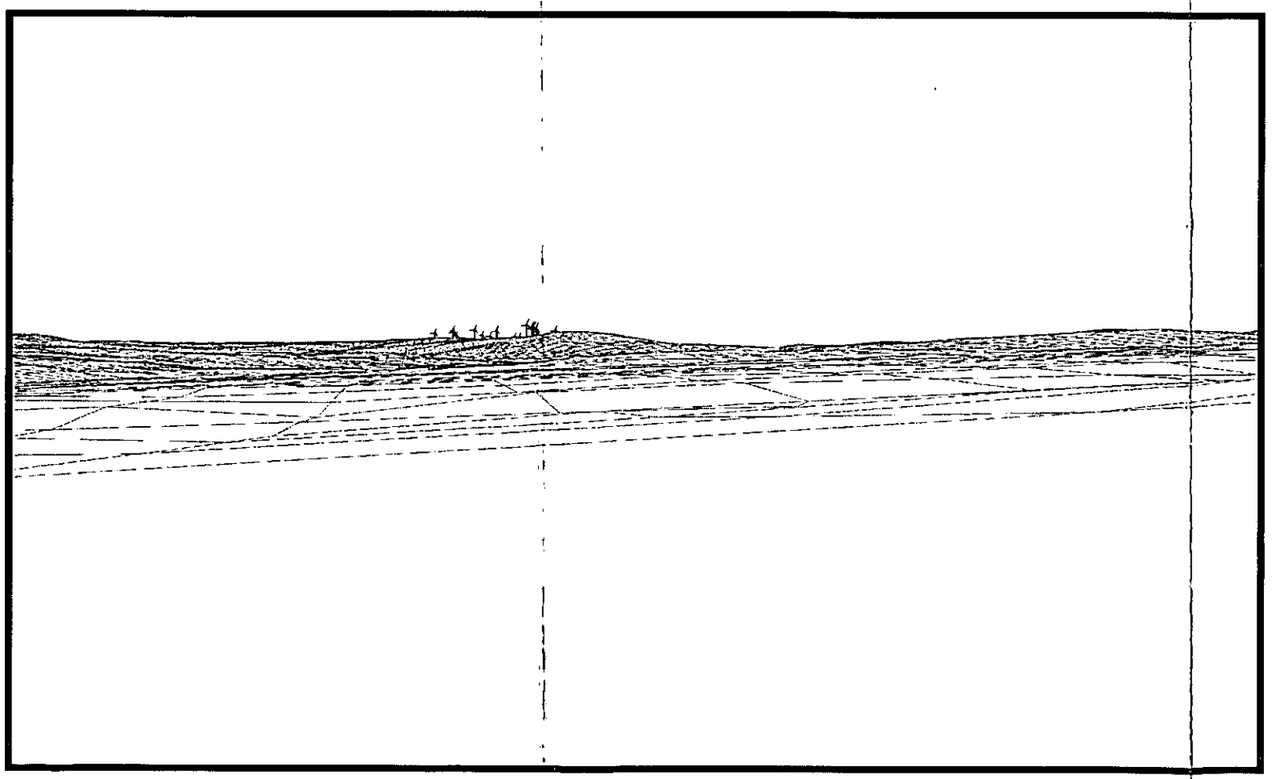
2000/134/06/bhill-eis_fig92



VIEW No. 1
From
Outside Abbeyfeale

PLANNING APPLICATION
FOR A PROPOSED WIND FARM SITE
AT TOORNAFULLA, Co. LIMERICK

FIGURE 9.2

Viewpoint 1 From the N21 outside Abbeyfeale

Description of View

Viewing direction is to the east from along the N21 approximately 1.5km east of Abbeyfeale and 6.9km from the nearest turbine. The view is taken from along a busy commuting route between Abbeyfeale and Newcastle West. The landscape is typical of a rural country landscape with hedgerows and grassy verges along the road edges and a number of deciduous and coniferous tress dotting the landscape. A number of road signs and telecom masts and overhead wires are also visible along the road edges. The land cover is mainly upland pasture and grassland. The landform slopes away from the road to the west of the view while the landform to the east of the view is hilly. Barnagh Hill can be clearly identified and encompasses a very large portion of the background view. The peak is not very prominent and slopes gently to form a plateau to the west of the view disappearing behind a house at the edge of the road.

Description of Landscape Impact

Up to 13 turbines from the proposed wind farm at Toornafulla will be visible. There is some sheltering of the turbines on the lower ground on the southern slope of Barnagh Hill behind the peak of the hill but on the whole visibility is high. There is little scope for shelter at this location as Barnagh Hill is very prominent in the landscape. There are no other features in the landscape at the point at which this viewpoint was taken to reduce the viewing potential. From this location also some of the turbines appear to be stacked behind one another.

Summary Impact

The impact of the development is moderate from this location due to the open nature of the landscape. There is no screening of the site and there will be clear views of the wind farm by passing motorist, however the site is nearly 7km away and the turbines appear as one small element in the landscape.

Viewpoint 2 Near Goulburn Bridge along the N21

Description of View

This viewpoint was taken from along the N21 approximately equidistant between Abbeyfeale and the site (approximately 3.2km to the nearest turbines). Viewing direction is to the east. The N21 dominates the viewpoint. Road signs, telegraph poles and overhead lines are located along the grassy verges of the road. The viewpoint is one of a rural landscape. A number of isolated houses are located along the road, many of which are sheltered by deciduous and coniferous trees along the road. The landform is gently sloping upwards to Barnagh Hill which appears as a smooth broad hill in the background. There are no dramatic terrain changes.

Description of Landscape Impact

Only 2 turbines from the wind farm will be clearly visible. Blade tips of another 4 will also be visible. Since the turbines are on the southern slope of Barnagh Hill the majority are hidden from this viewpoint. From this location the full extent of the wind farm cannot be viewed.

Summary Impact

The landscape quality is typical of a rural area. The impact of the wind farm from this location is low although the turbines are located at a distance of only 4km. Only two turbines are visible in the landscape.

Viewpoint 3 Outside the School at Templeglentan

Description of View

This viewpoint was taken from along the N21 approximately equidistant between Abbeyfeale and Newcastle West and only 1.2km from the wind farm. Viewing direction is to the southeast. The most dominant feature of the viewpoint is the large red brick detached residence against a backdrop of Barnagh Hill, which gently rises away from the viewpoint. The land cover comprises of grassland, defined by hedgerows and small copses. A number of deciduous trees are present in the foreground. There are no dramatic landscape features apparent from this viewpoint. The landscape sensitivity is low.

Description of Landscape Impact

Only 1 turbine will be clearly visible from this location. Potentially up to three towers in addition to blades from 3 turbines are visible. However hedgerows in the background will screen the site. Another turbine is hidden behind a tree to the right of the viewpoint. Another turbine will be hidden behind the house hence reducing visibility from the road.

Summary Impact

Given the low number of turbines visible and the screening of the site by roadside hedging and buildings as well as the low sensitivity of this landscape, the impact on the landscape is deemed to be low.

Viewpoint 4 Ballymurragh East

Description of View

This viewpoint was taken from along the N21 approximately 5km outside Newcastle West and approximately 3km from the wind farm. Viewing direction is to the south-west. The roadway dominates the fore and middle ground in addition to the fencing along the grassy verges, which extend into the background. A dwelling is visible in the middle ground and is surrounded by deciduous trees. The landform is of rolling hills with low relief. The high, more dramatic landforms of Sugar Hill and Mullaghareirk Mountain are not in view.

Description of Landscape Impact

Nine turbines can clearly be seen in the landscape. Blades from 5 turbines are also visible although these are less noticeable in the landscape. Screening potential for the 4 westerly turbines is low. These are dominant in the view. The other turbines are less dominant, being screened by trees and houses.

Summary Impact

The landscape is considered to have moderate sensitivity. Because of this and the fact that only 4 of the turbines will be clearly visible (west-bound traffic will have a lower viewing opportunity than that illustrated and east-bound traffic will be facing away from the wind farm) the impact of the wind farm from this location is considered moderate.

Viewpoint 5 Sugar Hill

Description of View

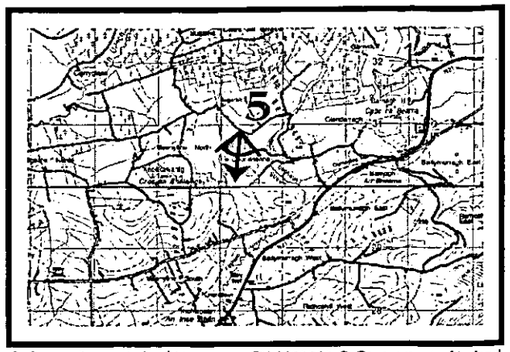
This viewpoint was taken from a county road on the southern slope of Sugar Hill. The viewing direction is to the south. The nearest turbine is 4.4km from the viewpoint. Because of the elevation of the viewpoint, the landform to the south appears relatively low-lying with low relief and gently undulating hills. The mosaic of fields evidences the human influence on the landscape. A number of isolated dwellings are visible scattered throughout the landscape.

Description of Landscape Impact

All of the turbines are visible from this location, either all or in part. Because of the vantage point, screening of the wind farm is limited.

Summary Impact

Again, because the landscape sensitivity is low and the distance from the site, the impact is considered moderate.



Notes:
Tip height = 100m
Included Angle = 100°
Camera height = 1.8m
Pitch Angle = 0.95°

Grid reference:120425 E, 130861 N
Distance: 4.42km (To nearest turbine)
Elevation: 232m
Number of tips visible: - 17
Number of hubs visible: - 17

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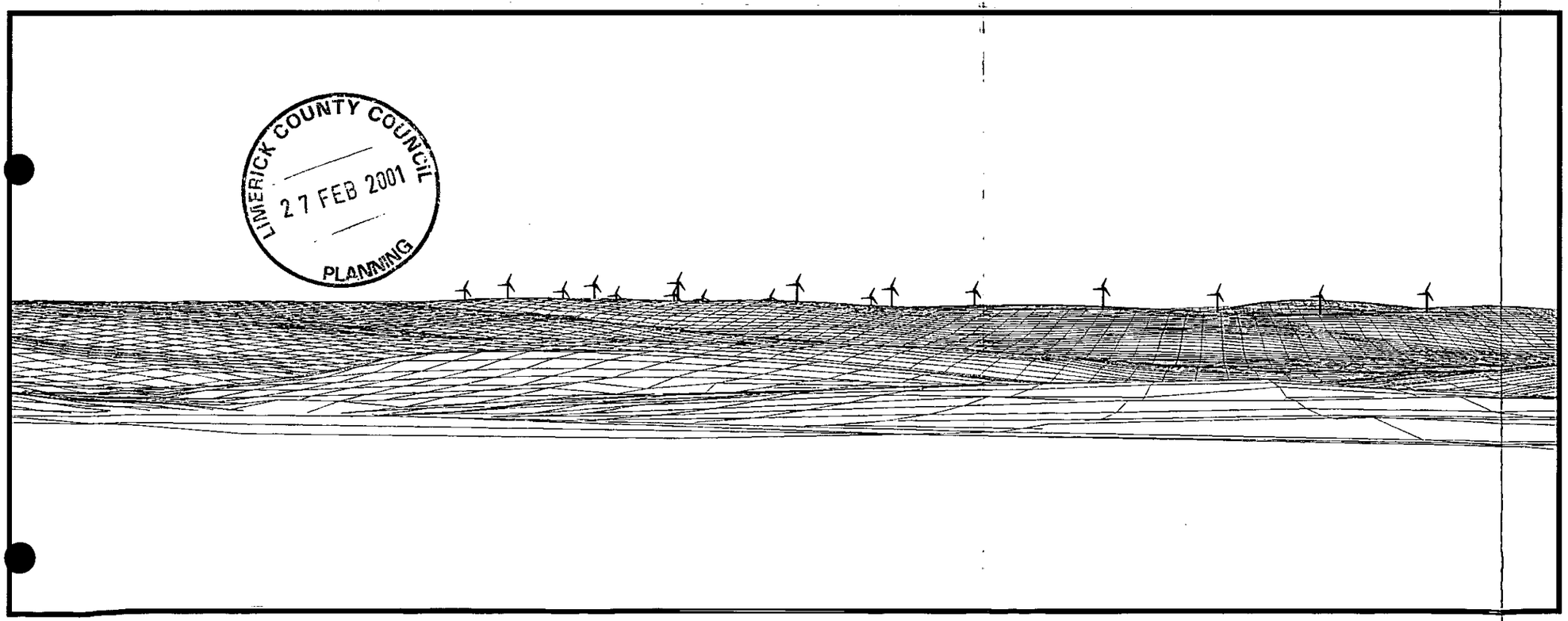
Prepared by
Fehily Timoney and Company,
Core House,
Pouladuff Road, Cork

FEHILY TIMONEY & COMPANY

DK/SK
2000/134/06/bhill-eis_fig96



VIEW No. 5
From
Sugar Hill

PLANNING APPLICATION
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AT TOORNAFULLA, Co. LIMERICK

FIGURE 9.6

Viewpoint 6 Outside Toornafulla Church

Description of View

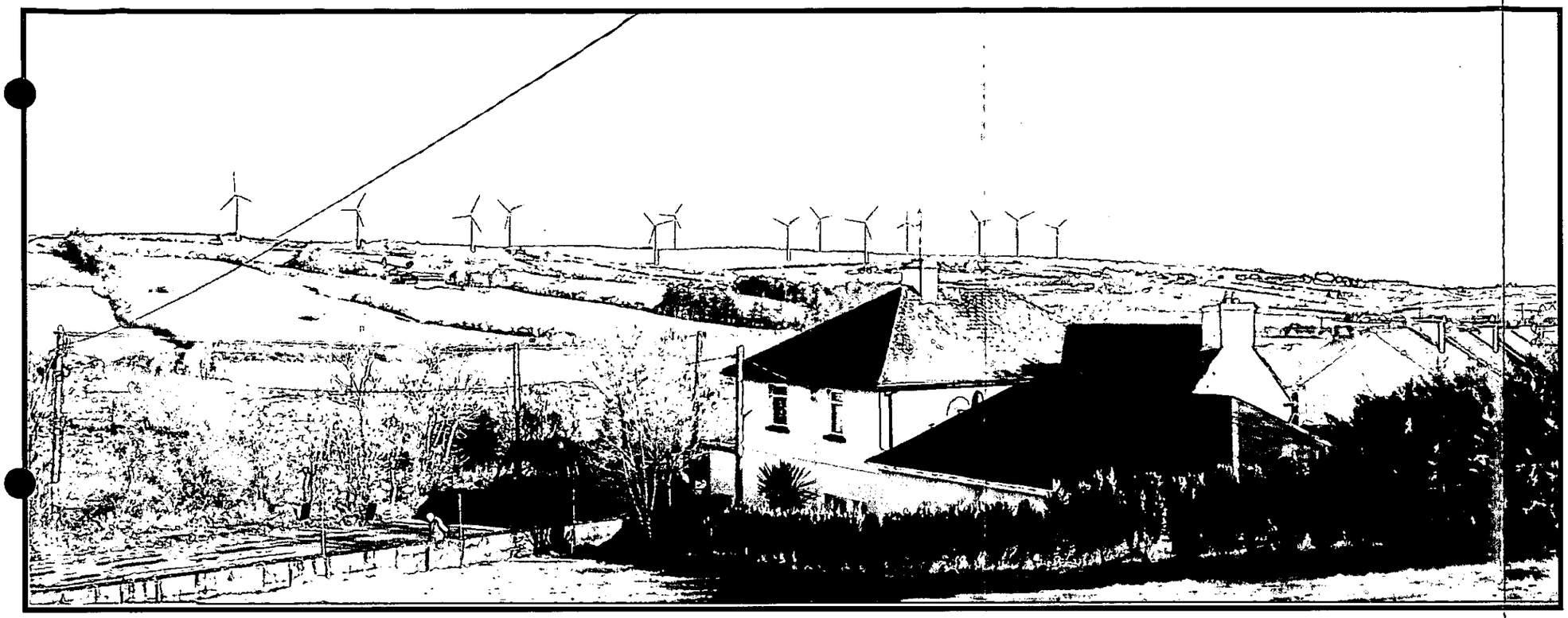
This viewpoint was taken outside Toornafulla church on an area of high ground with clear views of Barnagh Hill. A row of houses in the village with frontage towards Barnagh Hill is also visible in the viewpoint. Telegraph masts and overhead wires add to the human made aspect of the viewpoint. A row of conifers marks the church ground boundaries to the east of the viewpoint and provides some sheltering for the houses. A number of isolated conifer and deciduous plantations dot the landscape. A number of farmsteads and isolated houses are present in the middle and background. To the east of the viewpoint clusters of housing are visible along the R515. The field patterns and land cover can be clearly identified. Land cover consists of grassland and hedgerows dividing field boundaries. Barnagh Hill in the background appears as a smooth ridge gently sloping to the east of the view and rising slowly to the far corner of the viewpoint. This is clearly a working landscape, the human influence dominating the landform.

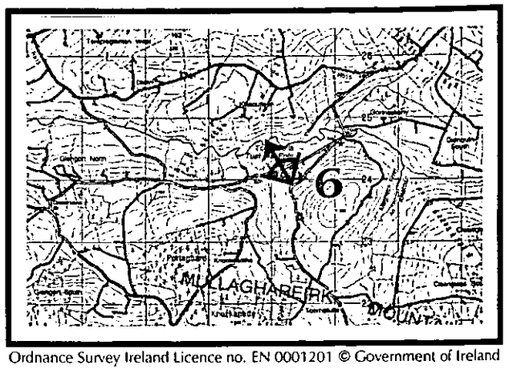
Description of Landscape Impact

The village of Toornafulla will have very clear views of the site. This viewpoint was taken from outside the church, which was selected as being an area where a large number of parishioners would congregate for church services. The church is also located on an area of high ground where there are uninterrupted views of the site. Only 14 turbines are captured in this viewpoint, although all 17 would be seen. The photographic view did not capture the remaining turbines to the west of the view location. The turbines are very prominent against the hill and there is no scope for sheltering from this location. The spatial pattern of the turbines appears staggered from this location.

Summary Impact

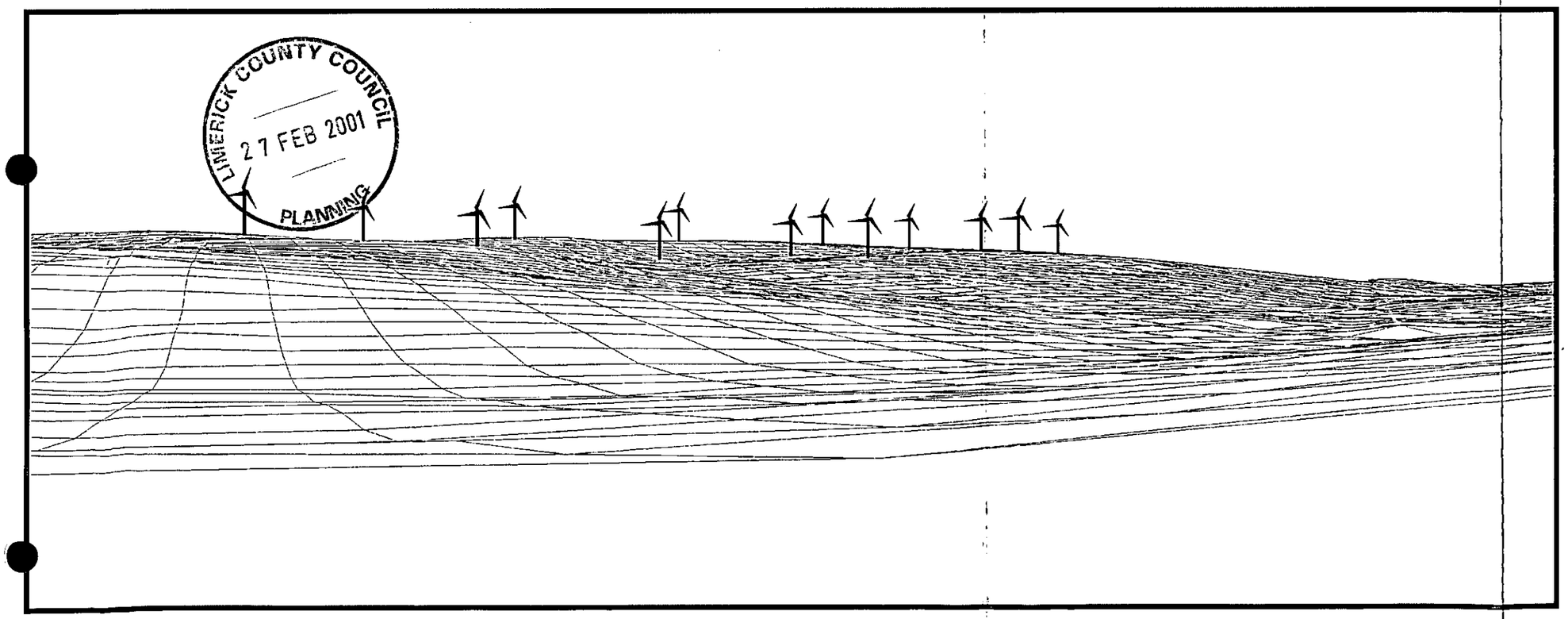
Although the wind farm will be highly visible from this location, the landscape sensitivity is low. The overall impact will be high because of the proximity.





Notes:
Tip height = 100m
Included Angle = 70°
Camera height = 1.8m
Pitch Angle = -0.22°

Grid reference:121277 E, 124052 N
Distance: 2.07km (To nearest turbine)
Elevation: 168m
Number of tips visible: - 13
Number of hubs visible: - 13



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Prepared by
Fehily Timoney and Company,
Core House,
Pouladuff Road, Cork

DK/SK
2000/134/06/bhill-eis_fig97

FEHILY TIMONEY & COMPANY

VIEW No. 6
From
Tournafulla Church

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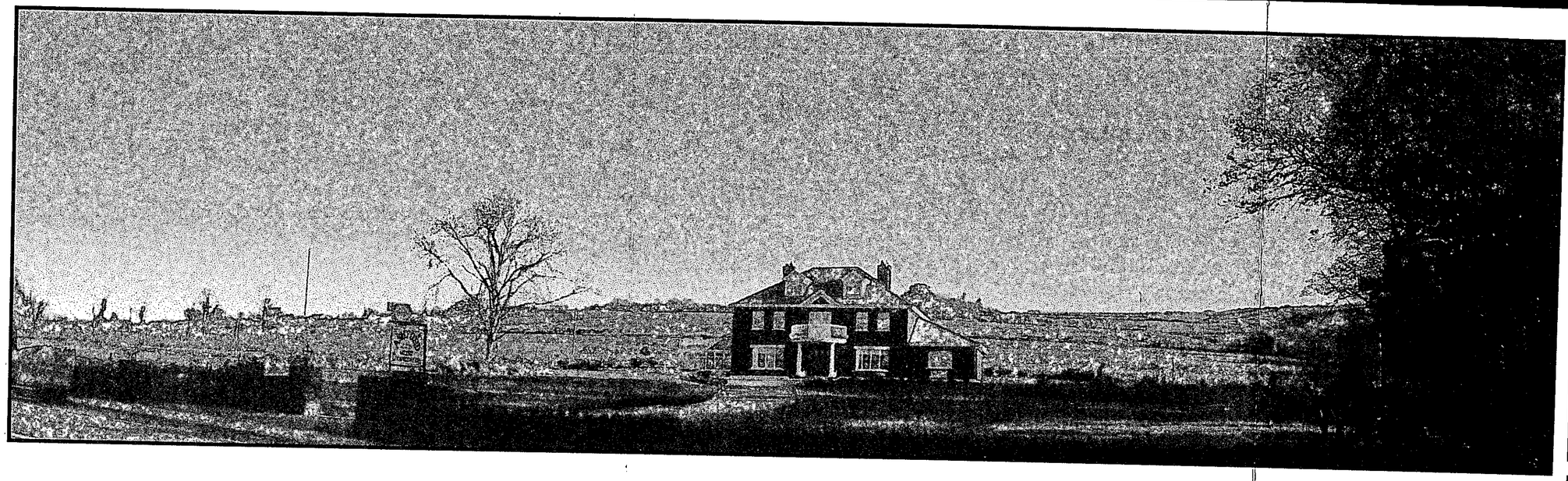
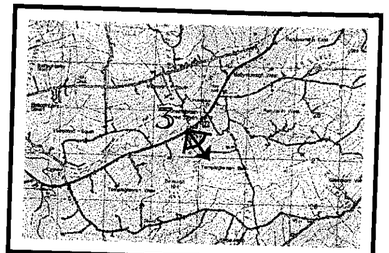
AT TOORNAFULLA, Co. LIMERICK

FIGURE 9.7





Notes:

Tip height = 100m
Included Angle = 75°
Camera height = 1.8m
Pitch Angle = 9.6°

Grid reference:119756 E, 127649 N
Distance: 1.19km (To nearest turbine)
Elevation: 117m
Number of tips visible: - 3
Number of hubs visible: - 1

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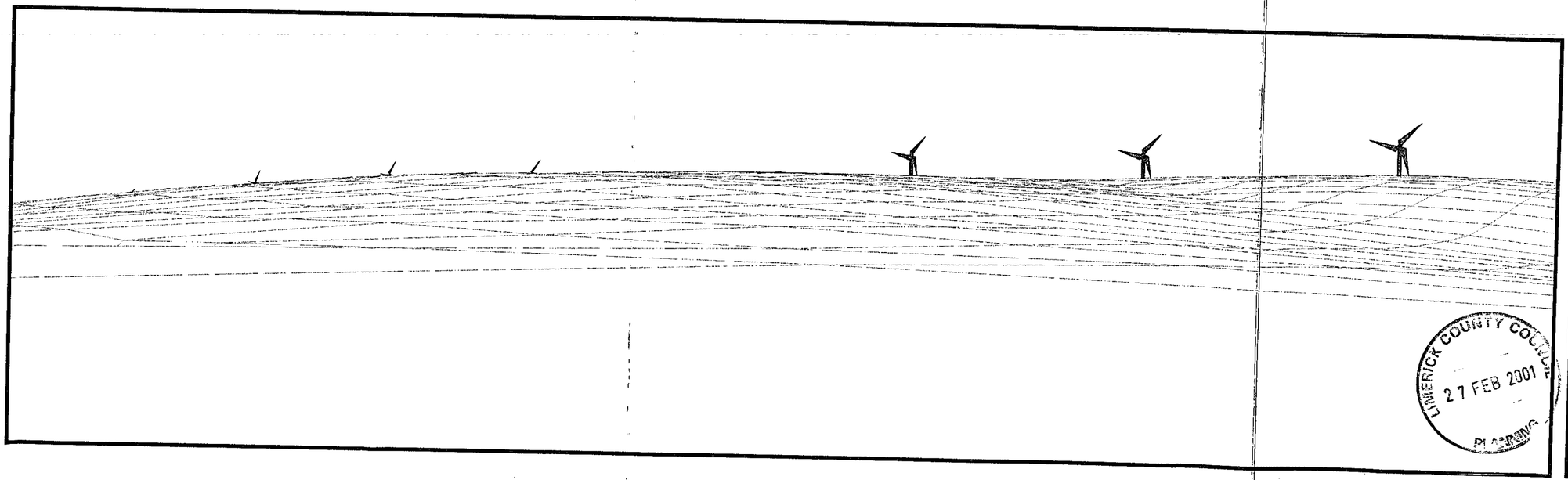

VIEW No. 3
From
Templeglentan School

PLANNING APPLICATION
FOR A PROPOSED WIND FARM SITE
AT TOORNAFULLA, Co. LIMERICK

FIGURE 9.4

9.5. Summary of Visual Impact

The quality of the landscape in the Toornafulla area is low to moderate because of the low relief of the landform and the worked nature of the landscape. The mountains to the north of the site and south of the site are considered to have a higher landscape quality. These areas are elevated, more rugged and at least appear to have less human influence.

The visual impact of a wind farm on the immediate area will not be significant due to the worked nature of the landscape. The wind turbines will relate to the overall human-made character of the landscape. The more sensitive landscape types are located at a distance from the site.

The design of the layout took into consideration the visual impact of the wind farm on the surrounding landscape. The layout of the turbines parallel to the contours of the hill relates to the curved nature of the hill. To avoid visual confusion the wind farm appears as a single feature, this relates the turbines to the landform of the area[31].

Despite good design practices, there will be some adverse visual impacts at particular locations. The 7 viewpoints selected as photomontages are representative of the visual impact of the proposed development in their particular locations. Table 9.2 shows that the level of impact varies within the study area but from many of the viewpoints used it is deemed to be in the lower order of magnitude.

Table 9.1 Estimated impact upon landscape from VPs

VP No.	Location	Summary Impact
1	Abbeyfeale	Moderate
2	Goulburn Bridge	Low
3	Templeglentan School	Low
4	Ballymurragh East	Moderate
5	Sugar Hill	Moderate
6	Toornafulla Church	High

In conclusion, the site proposed by Eirtricity Developments Ltd. appears to be suitable for wind farm development in light of the low sensitivity of the landscape and its human-made character.

9.5.1. Proposed Mitigation Measures

A number of general mitigation measures are included below.

- the site has been designed to minimise the visual impact by following the contour of the hill;
- matt non-reflective finishes will be used on all turbine components;
- powerlines between individual turbines and the substation will be placed underground;
- counter rotation of blades will be avoided;
- the number and extent of new track roads has been kept to a minimum and will be properly landscaped immediately following completion of works;
- existing hedgerows will be retained as intact as possible and where damage or removal is unavoidable, they will be replaced with planting of indigenous species; and
- the substation will be screened to minimise its visual impact, using trees and other vegetation.

10. LANDUSE

10.1. Landuse in the Existing Environment

The Toornafulla site covers an area of 184ha approximately. It is used for non-intensive cattle grazing and pasture.

The land around the site contains a number of housing clusters and farmsteads along the R515 and county roads around the site. The nearest centres of population to the site are at Toornafulla and Templeglentan, approximately 2km from the site. The larger towns of Abbeyfeale and Newcastle West are located at a distance of over 7km.

With the exception of the larger towns, the land use in the greater area is predominated by agriculture including dairy and tillage. Land use in the higher ground in the general area is dominated by coniferous plantations.

Toornafulla is not a major tourist area relative to other regions in County Limerick. The site has not been identified in the Limerick County Development Plan as an area of visual or scenic importance. Neither is it an area of scientific or recreational importance.

10.2. Characteristics of the Development which may Impact Upon Landuse

The development will have no major impact upon land uses such as the rough grazing or other agricultural activities.

Approximately 3.6ha of grazing land will be lost through the construction of site tracks and hardstanding. The remainder of the site can continue to be used for pasture/grazing. The loss of this rough grazing is not considered significant.

10.3. Mitigation Measures

Because of the relatively small land take needed for the development and the diversification of land use, the impact is considered positive and no mitigation measures are required.

11. MATERIAL ASSETS

Wind energy is a clean renewable and sustainable means of electricity generation. It is one of the most cost-effective energy options for reducing global warming. It does not result in the creation of any dangerous waste products. 80% of people polled are in favour of wind energy (European Wind Energy Association, 1999).

The development of the wind farm will have positive and negative impacts upon material assets in the receiving environment.

11.1. Positive Impacts on Material Assets

- in addition to avoiding harmful atmospheric emissions, wind energy is an indigenous, secure and sustainable resource in contrast to fossil fuels, which are ultimately unsustainable. Current rates of use of fossil fuels (coal, oil and gas) are 300,000 times greater than the rate at which these fuels are naturally created. While new resources of such fuels are continually discovered, these resources are finite. As these energy sources are depleted, they will accordingly become more expensive. The development of wind energy slows down this depletion and offers an alternative power source. Wind power development contributes to security and diversity of energy supply.

- the wind farm development will make effective use of land presently used for rough grazing. The local climatic conditions are very suitable for such development, this area being open and windy. The wind resource can be considered a material asset of County Limerick, which will now be utilised. Most of the site can continue to be utilised for rough grazing while the wind farm is in operation.

- the development of wind energy projects in rural areas provides an increased sustainable income for landowners, as the utilisation of their land can be diversified.

- the developer has given an undertaking to contribute 1% of gross earnings from the wind farm to the communities of Toornafulla and Templeglentan, estimated at £25,000/annum, assuming planning is granted for all 17 turbines.

11.2. Negative Impacts on Material Assets

Wind turbines can be considered to be an environmentally benign approach to energy generation or alternatively as an unwelcome intrusion on the landscape. To date there has been no evidence to suggest that tourism in an area may be negatively affected by the presence of a wind energy facility.

There are a significant number of residences in close proximity to the site, many of which will suffer negative impacts such as noise, shadow flicker, potential disruption to TV reception and visual impact. These impacts are readily soluble. However the visual impact is the most difficult to mitigate.

12.ELECTROMAGNETIC INTERFERENCE

12.1. Introduction

It is established that rotating blades of a wind turbine may occasionally cause interference to electro-magnetically propagated signals. While such interference can, in theory, have an impact on all forms of electromagnetic communications such as satellite communications, RADAR, cellular radio communications, aircraft instrument landing systems, terrestrial microwave links and television broadcasts, the location of the proposed wind farm and the nature of some of the signals eliminates from consideration all but the last two.

12.2. Potential Impacts of the Development

Interference to a communication system that is based on the propagation of electromagnetic waves can be of three forms: -

- electromagnetic Interference (EMI) emanating from the turbines, where interference frequencies are generated internally in the turbine and conflict with those which are legitimately propagating outside;
- signal scattering as a result of the obstruction presented by the blades, an effect that mimics the presence of a lower power source operating from the location of the wind turbine; and/or
- signal obstruction as it passes through the area swept by the rotating blade, and as a consequence, undesired modulation.

12.2.1. Electromagnetic Interference

An electric generator or motor will generate electromagnetic energy that will be propagated in the vicinity of the machine, and in this regard a wind turbine is no exception.

Like all electrical equipment, testing is required prior to sale to ensure that it meets the required European standard with regard to level of emissions (EN 55011) and immunity to interference (EN 61000). Prior to installation, such tests will have been carried out on the wind turbine, and so it is not expected that EMI will be a problem.

12.2.2. Signal Scattering

Large wind turbines can act as sources of re-radiation, producing delayed 'ghost' signals that are modulated in amplitude by the rotation of the blades. The amplitude of the re-radiated signals will be greatest when the plane in which the blades rotate is orientated so that the angle of incidence and reflection are equal.

This is called the 'specular reflection' condition. Because the blade of the wind turbine will turn into the wind about a vertical axis, specular reflection may occur for some proportion of the time.

Situations to be avoided so as to minimise this effect are those where the wind turbines stand on high ground overlooking a community of viewers, and where the viewer's antennae are pointing so that the re-radiated signals arrive at the principal lobe. The likelihood here is that the high ground will partially screen the viewers from the direct signal whereas the turbines will be in a region of relatively high signal strength; also antennae will not provide discrimination against the strong reflected signals.

12.2.3. Signal Obstruction

If the wind turbine turns through 90^0 from the specular reflection condition, it will act as an obstruction in the path of the wanted signal and will, in general, simply reduce the wanted field strength. While this effect is less significant than the generation of delayed signals in causing picture degradation, it is one that needs to be avoided in the case of point to point networks.

12.3. Site Survey

Communication with operators in the area (e.g. RTE) is ongoing to determine the potential for interference. The results of discussion with these operators will be forwarded to Limerick County Council.

The communication masts in the vicinity of the site are located just south of Barnagh Gap and to the north of Sugar Hill. These are located 2km and 8km, respectively, to the north of the site.

Any interference caused by wind farm developments has straightforward technical solutions. These solutions may include:

- relaying signals around the wind farm using new and/or existing antennae;
- relaying signals through the wind farm using relay transmitters mounted on the turbines; or
- cabling the signals beneath the site.

Any remedial measures required, will be undertaken by the developer.

13.INTERACTION OF THE FOREGOING

The interactions and interdependencies between the environmental impacts as discussed in the preceding chapters are addressed in this section.

The negative interactive effects include:

- visual impact;
- noise; and
- shadow flicker.

Positive interactive impacts include:

- replacement of fossil fuel generated electricity with wind-generated electricity resulting in reductions of CO_2, SO_2 and NO_x emissions to the atmosphere and other pollutants to the ecosystem. The environmental impact of the generation of the same amount of energy is therefore significantly less;
- diversification of land use. Currently the land use is low intensity agriculture. The proposed development will not impede on the existing land use, but rather provide an additional land use. The development of wind farms is considered by the EPA as an agricultural activity for the Irish Farmers Association is strongly supportive;
- utilising the wind energy potential of the County Limerick;
- sustained rental income for local landowners. The positive impact is linked to the diversification of land use;
- significant financial contribution to the parishes of Toornafulla and Templeglentan, amounting to £25,000/annum approximately. Eirtricity has given an undertaking to provide 1% of the gross income from the wind farm to the two communities in the vicinity of the site; and
- there will be a significant rates income for Limerick County Council. This income will be put to beneficial use for the County as a whole.

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APPENDICES

ENVIRONMENTAL IMPACT STATEMENT

FOR

A PROPOSED WIND FARM

AT

TOORNAFULLA

CO. LIMERICK

APPENDICES

Volume 3 of 3

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February 2001

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ENVIRONMENTAL IMPACT STATEMENT

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A PROPOSED WIND FARM

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APPENDICES

Volume 3 of 3

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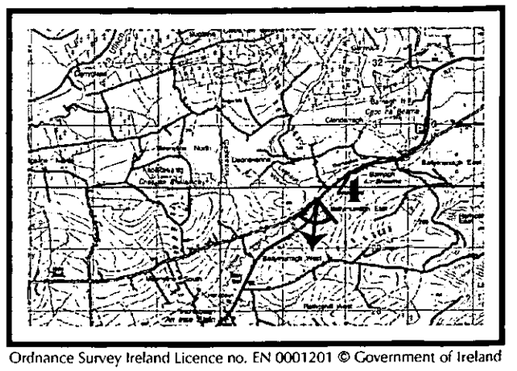
0	Issue to client	KOD	DK	DK	26/02/01

LIST OF APPENDICES



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Notes:

Tip height = 100m
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Grid reference:121549 E, 129763 N
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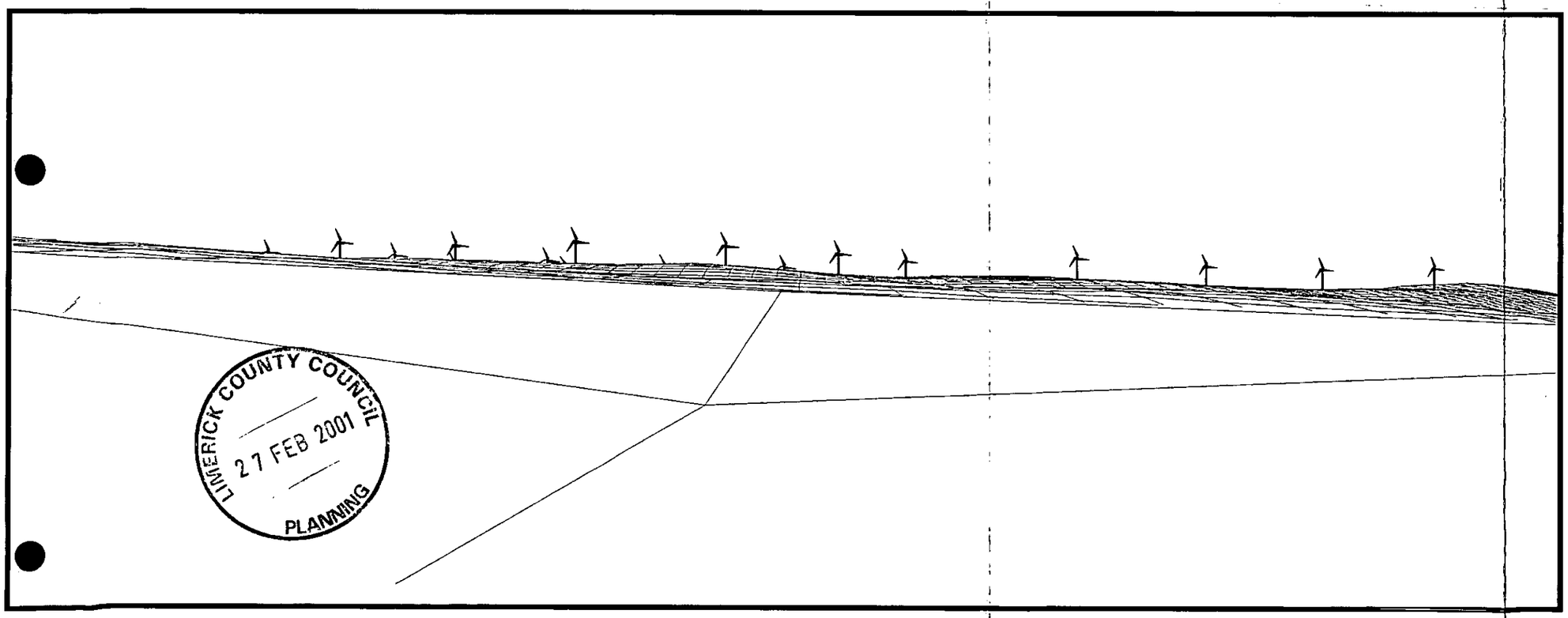

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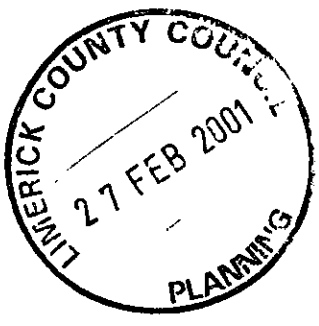
VIEW No. 4
From
Ballymurragh East

PLANNING APPLICATION
FOR A PROPOSED WIND FARM SITE
AT TOORNAFULLA, Co. LIMERICK

FIGURE 9.5

APPENDIX A

Executive Summary of the Strategy for the Intensification of Wind Energy Deployment



Executive Summary

The Renewable Energy Strategy Group was formed in November 1999 by Mr. Joe Jacob, T.D., Minister of State at the Department of Public Enterprise. The Group's terms of reference were set out in the September 1999 Green Paper on Sustainable Energy. This Green Paper reflected the Government's concerns about the need for domestic action to deal with the problem of climate change due to rising world emissions of greenhouse gases.

The principal focus of the Group's work in the initial 6 months, has been to develop a strategy for the increased contribution of onshore wind energy to electricity generation. In this period, the Group has examined many aspects of, and constraints to, the further deployment of wind energy. It is envisaged that the implementation of this strategy will assist the Department in delivering on the national targets up to 2005 for wind energy as set out in the *Green Paper on Sustainable Energy,* and inform future decisions regarding targets for the period 2005 – 2010.

The principal conclusion of the Group was that three key elements, *Electricity Market, Electricity Network* and *Spatial Planning,* need to be integrated into a plan led approach to wind energy deployment. Arising from the Group's deliberations, a number of recommendations are proposed under these headings. The recommended strategy, which hinges on this approach, is designed to meet the targets set for deployment of renewable energy at least cost.

The recommended plan-led approach sees spatial planning considerations as crucial in determining suitable areas where wind farms may be accommodated. These decisions should be informed by the availability of the resource (wind), the strength of the electricity networks, and landscape and other planning considerations. The locations thus identified should then determine the appropriate grid infrastructure required. Within the context of the agreed planning framework, the market mechanisms chosen should aim to minimise the cost of achieving the target deployment of wind energy.

Electricity Market

A major obstacle to the rapid deployment of wind energy is the uncertainty about the future of this market. The aim of the market mechanisms recommended in this report is to minimise unnecessary uncertainty and to provide a framework in which new operators will compete to provide the required generating capacity at minimum cost to future energy consumers.

For potential suppliers the stop-go nature of the tendering process, the administrative cost of tendering, and uncertainty about future policy all add to cost.

It is recommended that, in the short term, the market mechanism should concentrate on facilitating the development of capacity that has or can obtain the necessary authorisations, in particular planning permission, in years 1 or 2. Currently full planning permission has been awarded to wind farms with a combined installed electricity generating capacity of over 155 MW, not including AER III wind farms. An additional number with a combined installed capacity of over 160 MW are currently at various stages within the planning process. It is estimated that a further 215 MW are in the advanced stages of preparation for a planning application. To place this in context, the Green Paper target for all renewable energies is 500 MW by 2005.

Large Scale Developments

The market mechanism (AER V) recommended for the short term is to offer 15 year contracts for projects which have planning permission, the necessary licences and authorisations from CER and accredited certification. It is recommended that the price be based on projects delivered in the AER III competition corrected to allow for payment of the charges and levies introduced and approved by CER and the absence of AER III grants and linked to the Consumer Price Index. Essentially this will offer terms comparable to those arrived at through the competitive tendering process of AER III. It is recommended that this mechanism be available for 24 months to allow projects to enter and pass through the planning stages and to avail of the opportunity, in addition to the current projects with planning permission.

The Group feels that large scale wind farms should be encouraged to achieve efficient deployment of wind energy, and to avoid a proliferation of grid connections. In this regard, it is recommended that the project maximum size cap and ownership restrictions be removed.

The expected outcome from this scheme is an offer of power purchase agreements for large scale wind farms with a combined installed capacity of 160 MW within the 24 month period. This mechanism will be reviewed after 12 months to assess progress.

By offering a fixed price for a specified period the level of uncertainty, and related costs for promoters, will be reduced. By basing the price on that arrived at through a competitive tendering process the cost of provision will be minimised. Because of the speed of technical change in the industry it will only be appropriate that this price be held fixed for a limited period – 24 months – before a new price is determined through a competitive process.

Small Scale Developments

It is further recommended that a Small Scale Renewable Energy Scheme be maintained. The primary aim of this scheme is to encourage smaller scale projects in order to facilitate community based schemes. This provision is aimed at increasing public acceptance of wind energy and demonstrating the technology's potential to contribute to social cohesion and regional development.

It is recommended that for small-scale wind farms, the project size allowable be capped at, say, 2.5 MW and the price related to the small scale wind farm section within AER III (again corrected and linked to the Consumer Price Index, as in the case of the AER III contracts). In addition, because this scheme will be more expensive than the mechanism for deploying larger scale wind farms, there will be an overall cap of 40 MW for this scheme over the 24 month period.

Liberalised Market

In addition to these specialised market mechanisms, wind farms will be able to avail of the opportunities offered by the liberalisation of the electricity market. However indications are that such projects may suffer from an initial lack of confidence among support players, in particular banks, in the early trading stages of the green electricity market. Accordingly, the Group recommends that the Department of Public Enterprise bring forward proposals for an interim period and for a limited amount of capacity to assist projects aimed at that market in securing loans to finance their developments. The purpose of such proposals is to reassure lenders of a continued revenue stream from the wind farm for a limited period of, say, 8 years.

Signals to the market

The Group identified the uncertainty about future offers to the market as a key contributor to bottlenecks. This uncertainty has resulted in projects being submitted prematurely swamping planning authorities and the ESB's departments responsible for grid connection. Recent experience has seen ten applications for every one authorised. It is therefore recommended that a clear signal be sent out to the market that the Government is seriously committed to the target on deploying wind energy and that, as a result, a further round of offers will be held in the future on a competitive tendering basis (AER VI). The Group further recommends that, based on currently available information, the model comprising AER V and AER VI continue as a rolling programme into the medium term.

Review

It is recognised however, that the above medium term recommendations may be overtaken by a number of related developments. EU driven liberalisation in other sectors suggests there will be rapid development of binding (EU) competition and regulatory rules as the electricity market develops into a liberalised single market. Measures to meet the challenge facing Ireland and the EU by emission targets agreed under the Kyoto Protocol are likely to have a significant impact on wind energy deployment. Experience with trading green electricity in the liberalised electricity market will also provide a valuable insight into what may be required. The proposed EU Directive on the Promotion of Electricity from Renewable Energy sources in the internal market may also bring specific conditions on which types of market mechanism are allowable. Similarly the Guidelines on the application of state aid rules for environmental protection are due to be revised.In light of this, it is recommended that the Department of Public Enterprise carry

out a review mid way through the short term programme, i.e. during month 12, and at regular intervals thereafter, in order to determine the best possible route.

Electricity Network

The Group examined the electricity network from two perspectives, individual connections to the network (grid connections) and the ability of the network as a whole to accommodate increasing amounts of wind generated electricity. With regard *to grid connections*, in the context of delivering additional electricity generating capacity from wind energy, there is a serious shortage of capacity on the network. With regard to the *capacity acceptance*, the delivery of wind generated electricity poses challenges to the network which can limit the amount of such electricity acceptable while maintaining system security.

Grid Connection

The strategy recommended centres on facilitating grid upgrading in an efficient strategic manner. In the short term, it is recommended that funding available under the National Development Plan be invested in upgrading the distribution and transmission networks where a bottleneck exists. The priority locations for upgrading will depend on perceived demand (number of wind farms likely to be built) and planning considerations (projects with planning permission). As the projects come on stream, the cost of this infrastructural investment should be recovered through the pricing mechanism and should be recycled to support further infrastructural development.

In the medium to long term, it is recommended that greater integration with the spatial planning process should determine upgrading of the Distribution and Transmission networks, with information on resource availability and existing network strength as information inputs. It is recommended that the above mechanism for upgrading of the distribution and transmission networks be then carried out as in the short term (with the cost being recouped through appropriate user charges).

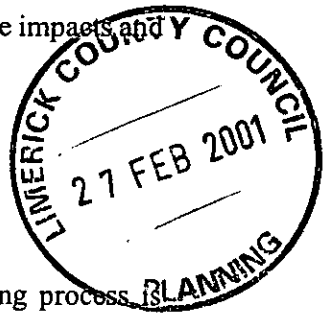
In addition, where strategic sites are identified for wind energy and where additional transmission infrastructure is required this grid upgrading should be funded under the National Development Plan. Once built however, this network extension will be available to all generators in a non-discriminatory fashion in line with national policy, and will not be reserved for wind farms.

Capacity Acceptance

The challenges to the network in accommodating wind generated electricity is a phenomenon which has yet to be fully researched. It is recommended that appropriate research studies be carried out in the short term to ensure that this does not become a constraint to reaching current and likely future targets for wind energy penetration. These studies are required in order to assess the likely impact of accelerated deployment and

the resulting growing proportion of wind generated electricity on the system as a whole. The current targets to 2005 indicate this proportion will grow from 1% currently to 7% by the end of 2005. It is assumed that the necessary prediction tools, controls and information systems can and will be developed to accommodate this accelerated deployment. In the event of this not being the case, it is noted that the Commission for Electricity Regulation, in granting licences to generate electricity, must have regard for system security.

A necessary outcome of such research will be to provide clear signals for the impacts and cost implications of new deployment targets in the period 2005 – 2010.



Spatial Planning

In the area of spatial planning, experience to date shows that the planning process is supportive generally of wind energy but emphasises a need for greater cohesion between energy policy and environmental / planning policy.

The key recommendation of the Group is that a more plan led approach to wind farm development be adopted. This process involves identifying areas which are deemed suitable or unsuitable for wind energy development, under the following categories

- Strategic areas – these key areas are deemed to be eminently suitable for wind farm development and should be reserved for such purposes.

- Preferred areas – these areas are suitable for wind farm development and should normally be granted planning permission unless specific local planning circumstances would support a decision to refuse permission in the context of the development plan.

- Areas open for consideration – applications for planning permission will be treated on their merits with the developer having a clear responsibility to demonstrate why the development should be granted permission.

- No-go areas – these areas are identified as particularly unsuitable for wind farm development.

The above areas may be identified by Local Authorities or on a regional or national basis and should all be incorporated into Local Authority development plans. In this way, the plan led approach should identify where wind energy should be developed. From this, appropriate market mechanisms may be determined and appropriate locations for investment in the grid infrastructure. The approach needs to be informed by the existing grid infrastructure, cost effective upgrade options and wind speeds for the areas identified. Planning instruments, which are currently being developed through legislation, will be utilised to facilitate this approach.

The process recommended to achive this is as follows:

1. Issue a letter of invitation to Local Authorities from the Minister for Public Enterprise and the Minister for the Environment and Local Government, pointing to the benefits to Local Authorities of wind farms in their area such as the rates, possibility of investment in wind farms themselves and the possibility of cheaper electricity (through supplying their own electricity needs with wind energy)
2. Local Authorities identify areas which are deemed preferred and open for consideration in the Local Authority area in the context of wind farm development. Strategic areas and no-go areas may also be identified, if deemed appropriate by the Local Authority.
3. The appropriate Council is advised on the areas on a provisional basis
4. The Local Authorities then submit maps containing these areas to the Renewable Energy Information Office to advise on the wind energy resource and the network strength for accommodating wind energy in these areas, following consultation with ESB, IWEA, etc.
5. A revised map of areas deemed preferred, open for consideration, strategic and no-go, as appropriate, is then produced by each Local Authority which is sufficiently broad to allow for wind energy development without creating a situation where difficulties with land availability would create potential bottlenecks.
6. The Local Authority then proceeds to incorporate this into its development plan.

It is recommended that the above process begin immediately. This will assist in providing guidance on individual proposals for planning permission to developers, local communities, the Local Authorities themselves and, in the event of an appeal, An Bord Pleanála.

The Group welcomes the preparation of Guidelines for Local Authorities on Landscape and Landscape Assessment. In carrying out such assessments, it is recommended that Local Authorities take into account wind farm developments. As part of the characterisation of the landscape it is recommended that Local Authorities determine, in parallel, the sensitivity of different landscape character types to different kinds of wind energy development. This will involve assessing landscape quality, sensitivity, robustness and capacity.

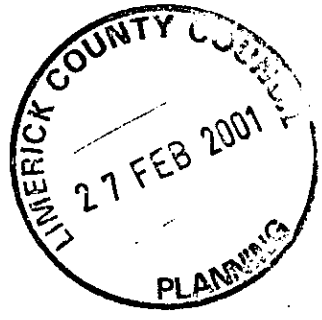
It is recommended that the Renewable Energy Information Office develop an integrated resource map specific to the needs of Planning Authorities, the network operator and wind farm developers. Because of its importance to other recommendations, it is further recommended that its production be completed as soon as possible. This map should be updated regularly and made available, in particular, to all Local Authorities.

It is recommended that objective research be undertaken of public objections to previous planning consent applications and subsequent attitudes to successful projects to inform a comprehensive information campaign by the Renewable Energy Information Office for

the purpose of informing and improving the public perception of wind farm developments.

It is further recommended that the Department of the Environment and Local Government revise and update their guidelines, *'Wind Farm Development – Guidelines for Planning Authorities'* to take account of recent developments, including the recommendations in this Strategy. In particular, it is important to incorporate the system and process, as recommended above.

In the medium term, it is recommended that the process outlined above should continue in an iterative manner and that as it develops, appropriate market mechanisms and grid upgrading plans for wind energy be informed by it.



APPENDIX B

Development Guidelines for Renewable Energy Developments

- Location - relative to residential areas, aquifers and groundwater, environmentally sensitive areas, special amenity areas and areas of archaeological potential in particular;
- Proposed working life of quarry;
- Working methods and hours of operation - frequency of blasting etc.;
- Noise generation and control;
- Dust generation and control;
- Waste disposal - waste rock, unmarketable products etc.;
- Water supply and discharge requirements;
- Impact on water table;
- Nature and extent of operations including ancillary operations;
- Transportation arrangements for products and road network in the area;
- Effects on amenity of the area and in particular residential, visual amenity;
- Reinstatement proposals - a financial bond is also required by the Planning Authority to safeguard against non-reinstatement; It should be noted that the record of past restoration by the developer will be taken into account.
- Natural and proposed screening of site.

17:33 Renewable Energy Developments

All methods of energy production have impacts on the environment. Notwithstanding this, the need to adopt a more sustainable approach to energy production is acknowledged by the Planning Authority. A favourable approach to applications for renewable energy developments provided they are environmentally sustainable will be adopted. The cumulative effect of such developments on the landscape will be taken into consideration.

Wind Farms.

The impact of a wind farm will vary depending on the location of the individual site together with the number of turbines, layout, size, design, and colour. In assessing an application for a wind farm the following shall be taken into consideration:-

Visual impact - both on site and over extensive areas. Applications may be required to include photo or video montages - taken from a variety of locations after discussion with the Planning Authority. Site cross section showing existing and proposed ground levels in relation to all structures on site are required. Ideally they should be sited against a backdrop of a hill or mountain. Non linear type layouts are favourable. Windfarms should not be intervisible from one another.

Predicted Noise Levels - developments must ensure that noise levels will not be intrusive in relation to background noise at the nearest dwelling. Blades, of single speed must rotate in the same direction . Monitoring noise levels at selected locations generally for the first year of operation of the wind farm will be a condition of planning permission. Manufacturers certification of noise emissions will be required at application stage.

Design:- Solid towers should be used. Towers of the same height should be used throughout the windfarm. Advertising material including the manufacturer's name or logo will not be permitted on the wind turbine.

Impact of associated site works - including access roads, substations, grid connections, fencing etc. Details of proposed grid connections are required at application stage. All grid connections should be undergrounded as far as

possible. Access roads shall be unsurfaced and follow natural contours of the site. Fencing will not be permitted on any part of the site except normal livestock fencing when the land is part of an operating agricultural holding.

Construction - a detailed phased programme for the construction together with estimates of traffic generation is required at application stage. Consideration will be given to the potential damage to roads during the construction phase. In some cases access routes may be restricted by planning condition.

Proximity To Dwellings. - Wind turbines should generally not be located within 500m of any dwelling but this may vary from site to site.

Interference with **navigation, television and communication signals.** A communications booster may also be required or some other technical solution. Air and sea navigation authorities may be consulted for their comments on proposed wind farm developments.

Impact on **environmental designations** - Amenity areas, Designated Tourist Areas, Natural Heritage Areas, Special Protection Areas, Archaeological sites etc. Wind farm developments should not be located within 100 metres of ancient monuments. The impact on migratory birds in particular will be assessed in consultation with the Irish Wildbird Conservancy.

Decommissioning - proposals for restoration of the site after removal of the turbines should be included with an application. Adequate financial security will be required by planning condition.

Sensitivity of locations of folklore, mythology and religious significance to these developments.. Evidence of consultation with local community groups is an important element of planning for such a project. Developers will also be required to assess their proposals for the impact of shadow flicker on dwellings and this information should accompany the planning application.

Location relative to **water bodies.** Wind farm developments should not be located within 150m of lakes or streams nor within 100metres of the Estuary.

Applicants are advised to outline future extension proposals if known. It should be noted that temporary permissions for an anemometer is without prejudice to any subsequent application for a wind farm.

Hydroschemes.

There will be a presumption in favour of applications for hydroschemes provided certain planning and environmental criteria are satisfied. Generally applications for hydroschemes will be assessed having regard to:

Impact on **environmental designations** - Amenity Areas, Natural Heritage Areas, Special Protection Areas, Archaeological sites, areas with significant amenity use etc.

Visual impact arising from turbine houses, embankments, structures, roads etc.

Impact on marine life, - Projects should incorporate a fish pass to ensure the free and safe passage of fish. The views of the local Regional Fisheries Board may be sought.

Likely **erosion** arising from the development.

Noise Generation - turbines should be sited at sufficient distance from dwellinghouses to ensure that noise emissions are not a nuisance.

APPENDIX C

Information Package Sent to Interested Parties

«Title»«FirstName»«LastName»
«JobTitle»
«Company»
«Address1»
«Address2»
«City»
«State»

29th September, 2000

RE: Development of a Wind Farm in Barnagh Hill, Co. Limerick

Dear «Salutation»

Eirtricity has retained Fehily Timoney & Co. (FTC) to prepare an Environmental Impact Statement (EIS) for a proposed wind farm project at Barnagh Hill, Co. Limerick. The EIS will accompany the planning application for the development to be submitted to Limerick County Council. As part of the EIS process, consultation with interested parties is sought. A brief description of the development is provided herein. Any comments or concerns regarding the development can be submitted to FTC for consideration in the preparation of the EIS.

Location

A map showing the location of the site is attached. The site is located in a rural area approximately 1km north of Inchabaun. The site covers an area of approximately 260ha and is made up of agricultural land, predominantly pasture.

Continued ../...

Proposed Development

The proposed development will consist of the following:

- Approximately 21 No. wind turbines maximum hub height of 67m;
- Control building;
- Site compound to include electrical pylon, transformer and other electrical hardware; and
- Connection to the national grid.

The development will provide to the national grid up to approximately 32MW of electricity produced by a clean energy source.

The EIS will address the various aspects of the environment on which the development may have an impact. These will include visual impact, ecology, noise, landscape, material assets, water and geology. Any comments regarding the proposed development should be received by 31st October 2000 for consideration.

If you have any questions, please contact the undersigned.

Yours sincerely

Dan Keohane

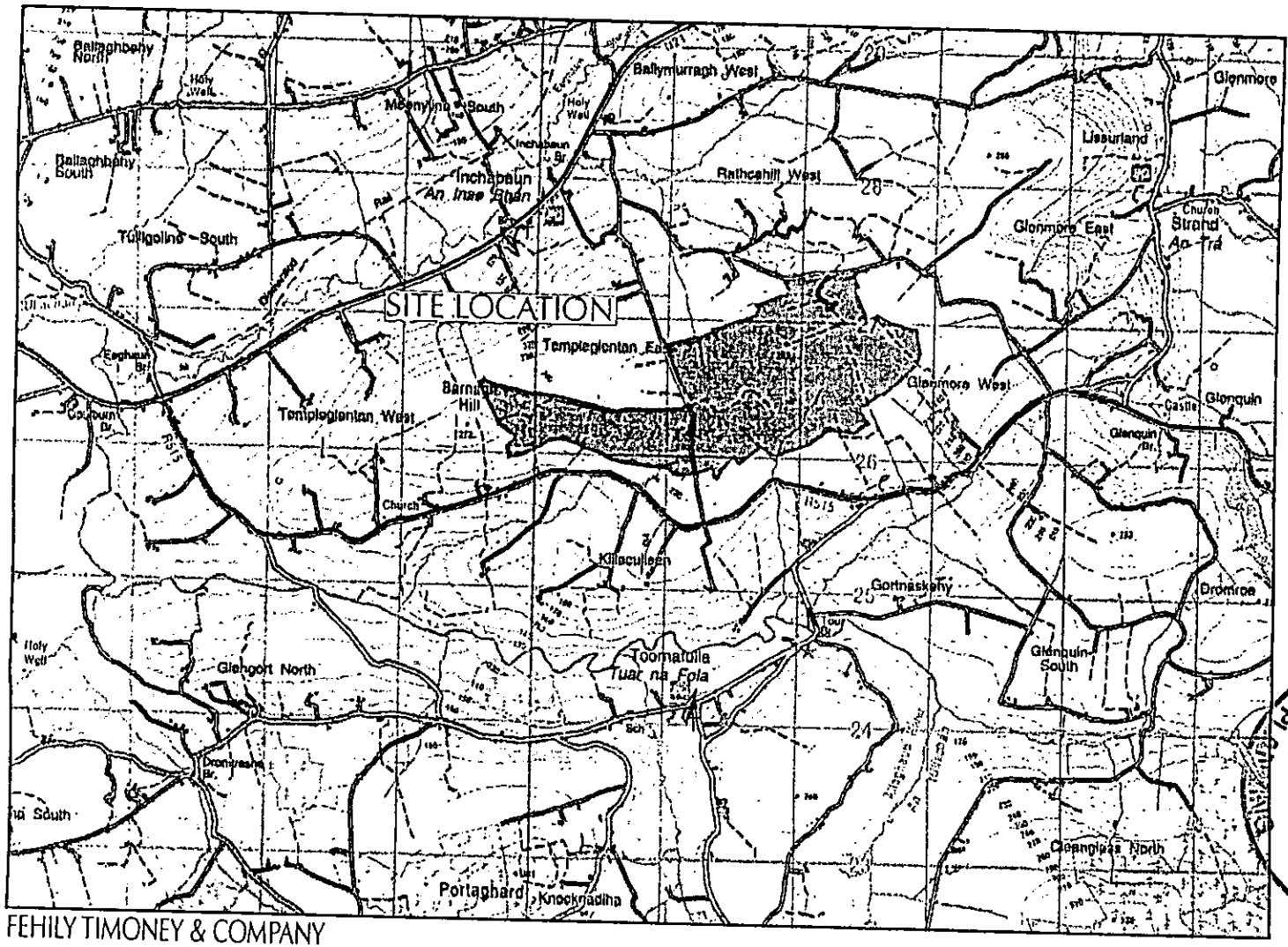
Encl.

Q:\2000\134\06\letters\Old letters\BHILL-EIS_Let1-29th Sept.doc(GO'S/DK/SB/AM)

REVISION A
SK/DK

JUNE 2000
2000\134\03\bhill-eis_fig1

CDR



FEHILY TIMONEY & COMPANY

1:50,000 SITE LOCATION MAP

FIGURE 1.

Our Ref:Q:\2000\134\06\Let003\BT

«Title»«FirstName»«LastName»
«JobTitle»
«Company»
«Address1»
«Address2»
«City»
«State»

26th February, 2001

RE: Development of a Wind Farm in Tournafulla, Co. Limerick

Dear «Salutation»

Eirtricity Development Ltd. has retained Fehily Timoney & Co. (FTC) to prepare an Environmental Impact Statement (EIS) for a proposed wind farm project at Tournafulla, Co. Limerick. The EIS will accompany the planning application for the development to be submitted to Limerick County Council. Consultation with interested parties is sought. A brief description of the development is provided herein. Any comments or concerns regarding the development can be submitted to FTC for consideration.

Location

A map showing the location of the site is attached. The site is located in a rural area approximately 2km north of Tournafulla. The site covers an area of approximately 184ha and is made up of agricultural land, predominantly pasture.

Continued ../...

Proposed Development

The proposed development will consist of the following:

- 17 wind turbines with maximum hub height of 65m;
- Electrical Control building;
- Construction of site tracks; and
- Meteorological monitoring mast (50m).

The development will provide to the national grid up to approximately 26MW of electricity produced by a clean energy source.

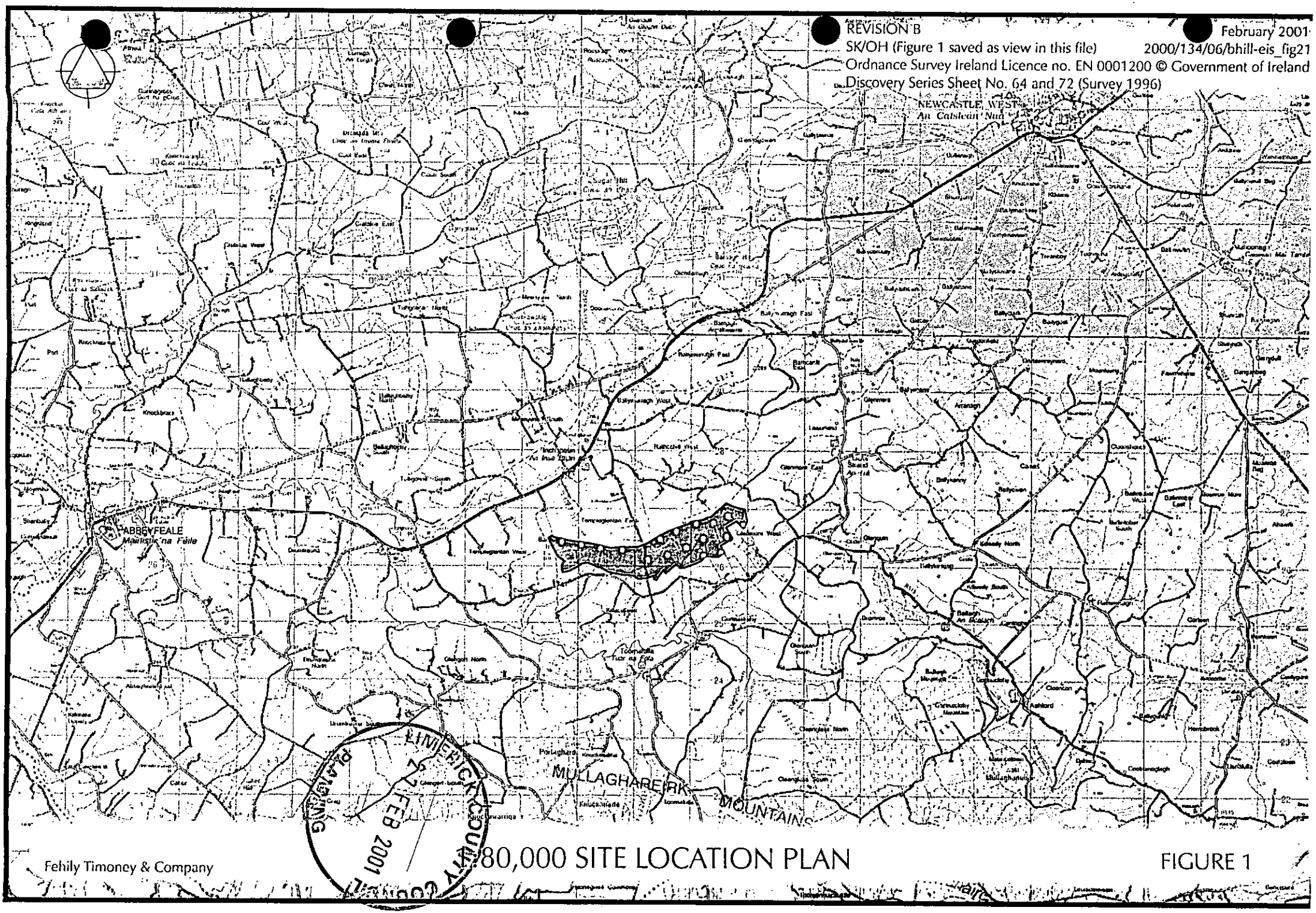
The EIS will address the various aspects of the environment on which the development may have an impact. These will include visual impact, ecology, noise, landscape, material assets, water and geology. Any comments regarding the proposed development should be received by 31st March 2001 for consideration.

If you have any questions, please contact the undersigned.

Yours sincerely

Orla Hussey

Encl.



Fehily Timoney & Company

1:80,000 SITE LOCATION PLAN

FIGURE 1

APPENDIX D

Open Day Poster

TOORNAFULLA
PUBLIC INFORMATION DAY
On Proposed Wind Turbine Project

Venue: Toornafulla Community Hall.

Date: Friday 16th February 2001.

Time: 2 p.m. to 8 p.m.

On Display

- **The Irish Energy Centre will have a stand with information on renewable energy and a selection of publications to take away will be available.**
- **Information and operation of wind turbines.**
- **Possible location of wind turbines.**
- **Details of proposed 40-metre wind measuring pole.**

The following people will attend to answer questions:

- **Finbar Tymon - Wind Turbine Consultant.**
- **Joe O'Mahony - Wind Turbine Consultant.**
- **Paul Kellet - From the Irish Energy Centre.**

The proposed wind farm will make a contribution of 1% of its gross earnings to the parishes of Toornafulla and Templeglentan. This will amount to about £ 1,500 per 1.5 MW wind turbine in each parish.

To have adequate time for all to view the display and to discuss any relevant matter with the people listed above it is requested that those who can attend early do so.

APPENDIX E

Shadow Flicker Model Results

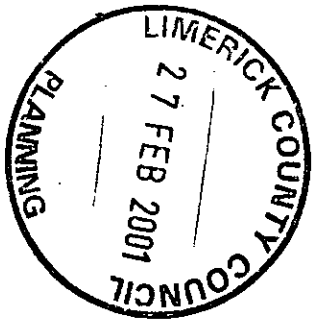
Project : BHILL-EIS_WINDFARM
Run Name : C:\WFARM\2000\134\06\BARNAGH HILL\LAYOUT 12-02-01.WFK
Title :
Time : 09:06:27, 26 Feb 2001

SUMMARY OF SHADOW TIMES ON EACH WINDOW

House/ Window		Easting	Northing	Width (m)	Depth (m)	Height (m)	Degrees from North	Tilt angle	Days per year	Max hours per day	Mean hours per day	Total hours
1/	1	119501	125659	1.0	1.0	2.0	130.0	0.0	0	0.00	0.00	0.0
2/	1	119596	125699	1.0	1.0	2.0	130.0	0.0	0	0.00	0.00	0.0
3/	1	119648	125712	1.0	1.0	2.0	130.0	0.0	0	0.00	0.00	0.0
4/	1	119709	125735	1.0	1.0	2.0	120.0	0.0	0	0.00	0.00	0.0
5/	1	120214	125902	1.0	1.0	2.0	90.0	0.0	0	0.00	0.00	0.0
5/	2	120214	125902	1.0	1.0	2.0	125.0	0.0	0	0.00	0.00	0.0
6/	1	120373	125851	1.0	1.0	2.0	0.0	0.0	38	0.34	0.27	10.1
6/	2	120373	125851	1.0	1.0	2.0	90.0	0.0	38	0.35	0.27	10.2
6/	3	120373	125851	1.0	1.0	2.0	130.0	0.0	38	0.35	0.27	10.2
7/	1	120456	125899	1.0	1.0	2.0	90.0	0.0	40	0.38	0.30	11.9
7/	2	120456	125899	1.0	1.0	2.0	140.0	0.0	40	0.38	0.30	11.9
7/	3	120456	125899	1.0	1.0	2.0	0.0	0.0	40	0.38	0.30	11.8
8/	1	120512	125899	1.0	1.0	2.0	95.0	0.0	46	0.41	0.32	14.6
8/	2	120512	125899	1.0	1.0	2.0	160.0	0.0	46	0.40	0.32	14.5
8/	3	120512	125899	1.0	1.0	2.0	0.0	0.0	76	0.40	0.27	20.8
9/	1	120807	125773	1.0	1.0	2.0	90.0	0.0	67	0.36	0.32	21.3
9/	2	120807	125773	1.0	1.0	2.0	145.0	0.0	67	0.36	0.32	21.1
9/	3	120807	125773	1.0	1.0	2.0	0.0	0.0	67	0.36	0.32	21.2
10/	1	121056	125535	1.0	1.0	2.0	120.0	0.0	0	0.00	0.00	0.0
10/	2	121056	125535	1.0	1.0	2.0	0.0	0.0	0	0.00	0.00	0.0
10/	3	121056	125535	1.0	1.0	2.0	40.0	0.0	0	0.00	0.00	0.0
11/	1	121164	125504	1.0	1.0	2.0	90.0	0.0	0	0.00	0.00	0.0
11/	2	121164	125504	1.0	1.0	2.0	120.0	0.0	0	0.00	0.00	0.0
11/	3	121164	125504	1.0	1.0	2.0	0.0	0.0	0	0.00	0.00	0.0
12/	1	121353	125561	1.0	1.0	2.0	90.0	0.0	0	0.00	0.00	0.0
13/	1	121425	125581	1.0	1.0	2.0	90.0	0.0	0	0.00	0.00	0.0
13/	2	121425	125581	1.0	1.0	2.0	0.0	0.0	0	0.00	0.00	0.0
14/	1	121766	125786	1.0	1.0	2.0	90.0	0.0	39	0.32	0.26	10.2
15/	1	122043	125820	1.0	1.0	2.0	160.0	0.0	0	0.00	0.00	0.0
15/	2	122043	125820	1.0	1.0	2.0	90.0	0.0	0	0.00	0.00	0.0
15/	3	122043	125820	1.0	1.0	2.0	0.0	0.0	42	0.37	0.29	12.3

Project : BHILL-EIS_WINDFARM
Run Name : C:\WFARM\2000\134\06\BARNAGH HILL\LAYOUT 12-02-01.WFK
Title :
Time : 09:06:27, 26 Feb 2001

16/	1	122076	125817	1.0	1.0	2.0	90.0	0.0	0	0.00	0.00	0.0
16/	2	122076	125817	1.0	1.0	2.0	0.0	0.0	40	0.35	0.28	11.0
17/	1	122118	125810	1.0	1.0	2.0	90.0	0.0	0	0.00	0.00	0.0
17/	2	122118	125810	1.0	1.0	2.0	0.0	0.0	36	0.34	0.27	9.7
18/	1	122199	125785	1.0	1.0	2.0	90.0	0.0	0	0.00	0.00	0.0
18/	2	122199	125785	1.0	1.0	2.0	0.0	0.0	18	0.18	0.14	2.6
19/	1	122318	125761	1.0	1.0	2.0	45.0	0.0	0	0.00	0.00	0.0
19/	2	122318	125761	1.0	1.0	2.0	0.0	0.0	54	0.38	0.32	17.3
19/	3	122318	125761	1.0	1.0	2.0	90.0	0.0	0	0.00	0.00	0.0
20/	1	122428	125746	1.0	1.0	2.0	45.0	0.0	0	0.00	0.00	0.0
20/	2	122428	125746	1.0	1.0	2.0	0.0	0.0	70	0.34	0.29	20.0
20/	3	122428	125746	1.0	1.0	2.0	150.0	0.0	0	0.00	0.00	0.0
21/	1	122451	125686	1.0	1.0	2.0	90.0	0.0	0	0.00	0.00	0.0
21/	2	122451	125686	1.0	1.0	2.0	0.0	0.0	0	0.00	0.00	0.0
21/	3	122451	125686	1.0	1.0	2.0	45.0	0.0	0	0.00	0.00	0.0
22/	1	122395	125607	1.0	1.0	2.0	90.0	0.0	0	0.00	0.00	0.0
22/	2	122395	125607	1.0	1.0	2.0	45.0	0.0	0	0.00	0.00	0.0
22/	3	122395	125607	1.0	1.0	2.0	0.0	0.0	0	0.00	0.00	0.0
23/	1	122072	125343	1.0	1.0	2.0	90.0	0.0	0	0.00	0.00	0.0
23/	2	122072	125343	1.0	1.0	2.0	45.0	0.0	0	0.00	0.00	0.0
23/	3	122072	125343	1.0	1.0	2.0	0.0	0.0	0	0.00	0.00	0.0
24/	1	122552	125753	1.0	1.0	2.0	80.0	0.0	0	0.00	0.00	0.0
24/	2	122552	125753	1.0	1.0	2.0	40.0	0.0	0	0.00	0.00	0.0
24/	3	122552	125753	1.0	1.0	2.0	0.0	0.0	0	0.00	0.00	0.0
25/	1	122639	125769	1.0	1.0	2.0	80.0	0.0	0	0.00	0.00	0.0
25/	2	122639	125769	1.0	1.0	2.0	45.0	0.0	0	0.00	0.00	0.0
25/	3	122639	125769	1.0	1.0	2.0	0.0	0.0	0	0.00	0.00	0.0
26/	1	122724	125797	1.0	1.0	2.0	80.0	0.0	0	0.00	0.00	0.0
26/	2	122724	125797	1.0	1.0	2.0	0.0	0.0	42	0.32	0.27	11.2
27/	1	122775	125823	1.0	1.0	2.0	80.0	0.0	0	0.00	0.00	0.0
27/	2	122775	125823	1.0	1.0	2.0	0.0	0.0	62	0.33	0.27	18.8
28/	1	122757	125805	1.0	1.0	2.0	70.0	0.0	0	0.00	0.00	0.0
28/	2	122757	125805	1.0	1.0	2.0	0.0	0.0	54	0.33	0.29	15.5
29/	1	122860	125827	1.0	1.0	2.0	70.0	0.0	0	0.00	0.00	0.0
29/	2	122860	125827	1.0	1.0	2.0	0.0	0.0	56	0.43	0.36	20.2
30/	1	122919	125815	1.0	1.0	2.0	70.0	0.0	0	0.00	0.00	0.0
30/	2	122919	125815	1.0	1.0	2.0	0.0	0.0	66	0.41	0.36	23.7



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31/	1	123100	125899	6.0	1.0	2.0	70.0	0.0	0	0.00	0.00	0.0
31/	2	123100	125899	1.0	1.0	2.0	0.0	0.0	36	0.34	0.26	9.4
32/	1	123211	125958	1.0	1.0	2.0	50.0	0.0	0	0.00	0.00	0.0
32/	2	123211	125958	1.0	1.0	2.0	0.0	0.0	74	0.44	0.38	28.5
33/	1	123329	125987	1.0	1.0	2.0	0.0	0.0	44	0.38	0.30	13.2
33/	2	123329	125987	1.0	1.0	2.0	40.0	0.0	0	0.00	0.00	0.0
34/	1	123382	126051	1.0	1.0	2.0	40.0	0.0	0	0.00	0.00	0.0
34/	2	123382	126051	1.0	1.0	2.0	0.0	0.0	35	0.36	0.28	9.7
35/	1	123395	126143	1.0	1.0	2.0	30.0	0.0	0	0.00	0.00	0.0
35/	2	123395	126143	1.0	1.0	2.0	0.0	0.0	91	0.38	0.32	28.9
36/	1	123606	126382	1.0	1.0	2.0	30.0	0.0	0	0.00	0.00	0.0
36/	2	123606	126382	1.0	1.0	2.0	0.0	0.0	85	0.42	0.32	27.4
37/	1	123857	126535	1.0	1.0	2.0	0.0	0.0	29	0.33	0.26	7.5
37/	2	123857	126535	1.0	1.0	2.0	40.0	0.0	0	0.00	0.00	0.0
38/	1	123672	126864	1.0	1.0	2.0	0.0	0.0	0	0.00	0.00	0.0
38/	2	123672	126864	1.0	1.0	2.0	180.0	0.0	30	0.39	0.31	9.2
39/	1	123028	127264	1.0	1.0	2.0	140.0	0.0	75	0.57	0.43	32.2
39/	2	123028	127264	1.0	1.0	2.0	170.0	0.0	75	0.58	0.39	46.1
40/	1	122698	127467	1.0	1.0	2.0	250.0	0.0	0	0.00	0.00	0.0
40/	2	122698	127467	1.0	1.0	2.0	90.0	0.0	0	0.00	0.00	0.0
40/	3	122698	127467	1.0	1.0	2.0	45.0	0.0	0	0.00	0.00	0.0
41/	1	122467	127426	1.0	1.0	2.0	90.0	0.0	0	0.00	0.00	0.0
41/	2	122467	127426	1.0	1.0	2.0	45.0	0.0	0	0.00	0.00	0.0
41/	3	122467	127426	1.0	1.0	2.0	260.0	0.0	17	0.18	0.14	2.4
41/	4	122467	127426	1.0	1.0	2.0	0.0	0.0	0	0.00	0.00	0.0
42/	1	122418	127408	1.0	1.0	2.0	260.0	0.0	7	0.08	0.06	0.4
42/	2	122418	127408	1.0	1.0	2.0	0.0	0.0	0	0.00	0.00	0.0
42/	3	122418	127408	1.0	1.0	2.0	45.0	0.0	0	0.00	0.00	0.0
43/	1	121913	127359	1.0	1.0	2.0	90.0	0.0	52	0.49	0.41	21.5
43/	2	121913	127359	1.0	1.0	2.0	0.0	0.0	0	0.00	0.00	0.0
43/	3	121913	127359	1.0	1.0	2.0	260.0	0.0	0	0.00	0.00	0.0
44/	1	121782	127624	1.0	1.0	2.0	90.0	0.0	17	0.16	0.13	2.2
44/	2	121782	127624	1.0	1.0	2.0	45.0	0.0	0	0.00	0.00	0.0
44/	3	121782	127624	1.0	1.0	2.0	0.0	0.0	0	0.00	0.00	0.0
44/	4	121782	127624	1.0	1.0	2.0	260.0	0.0	0	0.00	0.00	0.0
45/	1	121240	127498	1.0	1.0	2.0	90.0	0.0	53	0.33	0.29	15.5
45/	2	121240	127498	1.0	1.0	2.0	45.0	0.0	0	0.00	0.00	0.0

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45/	3	121240	127498	1.0	1.0	2.0	0.0	0.0	0	0.00	0.00	0.0
45/	4	121240	127498	1.0	1.0	2.0	260.0	0.0	0	0.00	0.00	0.0
46/	1	120958	126864	1.0	1.0	2.0	90.0	0.0	72	0.49	0.34	24.7
46/	2	120958	126864	1.0	1.0	2.0	0.0	0.0	0	0.00	0.00	0.0
46/	3	120958	126864	1.0	1.0	2.0	45.0	0.0	71	0.48	0.34	24.5
47/	1	120984	126712	1.0	1.0	2.0	90.0	0.0	74	0.56	0.39	28.9
47/	2	120984	126712	1.0	1.0	2.0	160.0	0.0	140	0.62	0.46	64.0
47/	3	120984	126712	1.0	1.0	2.0	45.0	0.0	74	0.56	0.39	28.7
48/	1	121038	126657	1.0	1.0	2.0	160.0	0.0	175	0.66	0.51	88.9
48/	2	121038	126657	1.0	1.0	2.0	0.0	0.0	0	0.00	0.00	0.0
48/	3	121038	126657	1.0	1.0	2.0	45.0	0.0	83	0.64	0.43	35.9
49/	1	121035	126579	1.0	1.0	2.0	0.0	0.0	34	0.42	0.33	11.3
49/	2	121035	126579	1.0	1.0	2.0	160.0	0.0	200	0.80	0.48	106.5
49/	3	121035	126579	1.0	1.0	2.0	45.0	0.0	81	0.67	0.44	38.1
50/	1	120826	127209	1.0	1.0	2.0	160.0	0.0	44	0.34	0.27	11.7
50/	2	120826	127209	1.0	1.0	2.0	45.0	0.0	0	0.00	0.00	0.0
50/	3	120826	127209	1.0	1.0	2.0	0.0	0.0	0	0.00	0.00	0.0