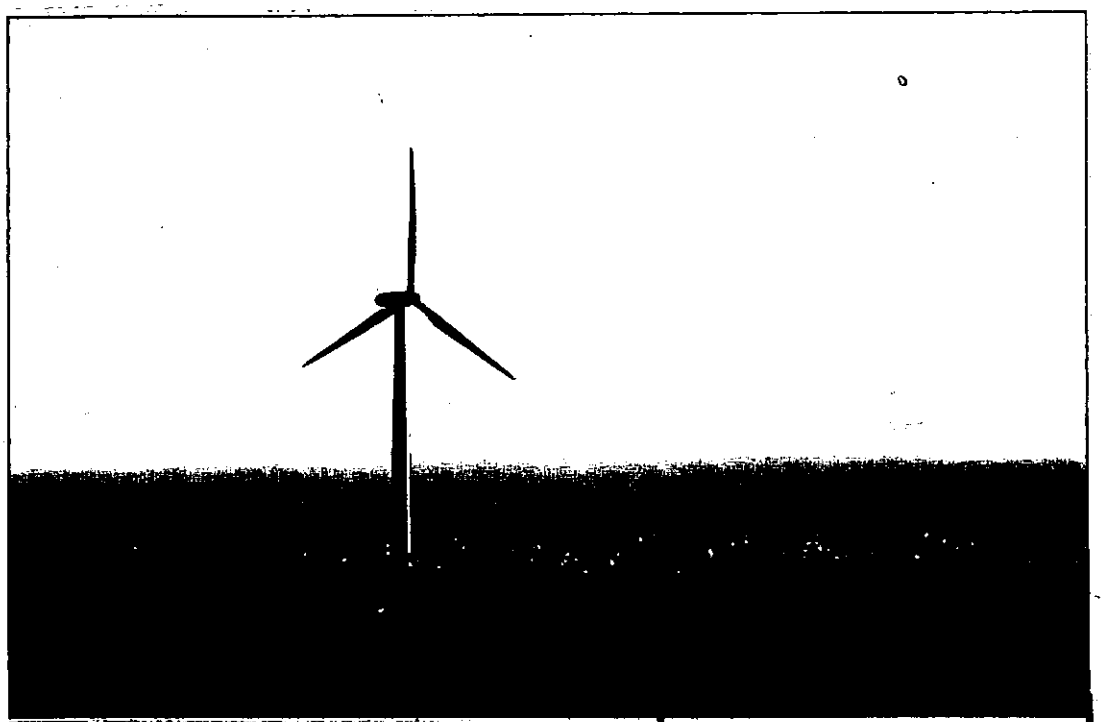
E15750

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING, UCC

MULLAGHMESHA WIND FARM

ENVIRONMENTAL IMPACT ASSESSMENT



Clients:

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MULLAGHMESHA WIND FARM

ENVIRONMENTAL IMPACT ASSESSMENT

TABLE OF FIGURES

TABLE OF PLATES

SUMMARY

THE PROPOSED DEVELOPMENT

The proposal is to construct a wind farm at Mullaghmesha, an upland area of between 400 m and 500 m elevation, 10 km north east of Bantry. The wind farm will generate electricity that will be transmitted to the ESB distribution network to meet local demand. The wind farm will have a maximum power output of approximately 12 MegaWatts (MW) generated by one of the following arrangements:

(i) 16 x 750 kW
(ii) 18 x 660 kW, or
(iii) 20 x 600 kW

A final decision on turbine size, number, and manufacturer will be taken following more detailed technical and financial evaluation of options.

In addition to the installation of the wind turbines the development will involve construction of on-site turbine access roads, upgrading of existing site access roads, and the construction of a 38 kV substation to connect to the ESB 38 kV distribution network. This will involve the construction of a minimum of 1.6 km of a new overhead line between the substation and existing lines.

THE PROPOSERS

South Western Services Ltd (SWS) are making the planning application on behalf of Green Power Ltd, a renewable energy company. SWS is part of an agricultural cooperative that was established in 1957 with shareholders from Bandon, Barryroe, Dairygold, Drinagh, and Lisavaird Cooperatives.

Green Power Ltd is a Macroom based company with a long track record of renewable energy development in the Munster region.

The proposed wind farm will be developed by a combination of Green Power and Fleming Construction (who will be involved in the construction of the wind farm) in the form of a new corporate entity established specifically for the development.

THE TECHNOLOGY

It is the intention of the developers to use the most modern and technically advanced wind turbines, manufactured by one of the following companies:

- Bonus Energy A/S
- NEG Micon A/S
- Nordex Balcke-Dürr GmbH
- Vestas - Danish Wind Technology A/S

This will ensure optimum energy production, reliable performance and safe operation of the wind farm. The output from the wind farm will supply local demand, and the wind data collected for the

site indicates that the power will be available for a high per centage of the time to meet demand, particularly in winter, when demand is highest. The calculated wind turbulence levels and characteristics are very suitable with respect to turbine performance specifications from the above turbine manufacturers.

THE BENEFITS

There will be local financial benefits during the development and construction phase, with a local spend of £1.5 million. In the longer term, there will be income from land rental and two full time operators.

The energy provided by the wind farm will be used in the West Cork area, and this form of embedded generation has been proved to be beneficial in relation to distribution line losses, and quality of electricity supply.

The long term involvement of a West Cork Coop and other Cork based companies will maximise the local economic benefits, and benefits relating to acquired technical expertise.

There are environmental benefits in relation to the displacement of electricity produced by fossil fuels. In particular, the reduction in greenhouse gas emissions resulting from the development would be approximately 45,000 tonnes per year.

ENVIRONMENTAL IMPACT

A detailed Environmental Impact Assessment was coordinated by the Department of Civil and Environmental Engineering, UCC, and the final design of the proposal reflects the recommendations of the assessment. The assessment covered the following aspects: visual impact, noise, electro-magnetic effects, health and safety, flora, fauna (birds), fauna: mammals (with observations on other fauna), archaeology, material assets (traffic, agriculture, waste, electrical demand), hydrology, air and climate, shadow flicker, and construction impacts. The visual impact was given special attention, and care was taken to minimise the number of wind turbines visible from a range of selected viewpoints. The proposed location at which the wind farm is to be connected to the ESB 38 kV line is at an elevation of over 100 m lower than the wind farm itself. This ensures that the overhead power lines and sub-station are not visually intrusive. With cooperation from the ESB, the length of the inter-connection line required to connect the sub-station to the existing 38 kV line will be approximately than 1.6 km. This again will reduce local visual impact from the development.

Wind farms are normally located on exposed landscapes due to their technical requirements for wind speed and wind consistency. While the visual impact of wind farms cannot be eliminated, good design practice will ameliorate any adverse visual impact to an acceptable degree for most receptors living within the visual envelope of the Mullaghmesha development. However for residents living within 1 km from any turbine in the overall array, a moderate to significant visual impact will result. With this in mind, SWS and Green Power carried out an extensive local information campaign involving house-to-house calls to assess the local reaction, discuss the proposal, and provide information on the proposal. The results indicated that the reaction was favourable or neutral.

PREAMBLE

CHARACTERISTICS OF THE PROPOSAL

INTRODUCTION - GENERAL CONTEXT

The proposal is a response to the announcement by the Junior Minister for Energy in April 1996 of the Renewable Energy Strategy for Ireland, in which a call was made for 90 MW of wind energy under the Alternative Energy Requirement III (AER3) programme. This programme invites Renewable Energy companies to tender for electricity supply to the ESB network. Green Power Ltd is also looking at an alternative market for the electricity produced, within the provision of Third Party Access for green electricity, whereby RE companies can sell directly to electricity users who wish to purchase electricity from an environmentally friendly renewable resource.

The proposal is to construct a wind farm to generate electricity from wind energy, and transmit this to the ESB national grid to supply electricity to meet local demand. This is known as embedded generation.[1]

The EU and other international energy and environmental bodies consider the electricity produced from RE sources as "green" electricity since it displaces electricity produced from fossil fuels, etc.

Energy and the Environment

The generation of electricity from fossil fuels (coal, oil, gas, and peat) produces a range of atmospheric pollutants and greenhouse gases that cause environmental damage. Carbon dioxide (CO_2) is a greenhouse gas, and approximately 1 kg of CO_2 is produced when 1 unit (1 kWh) of electricity is produced from fossil fuels. The International Panel on Climate Change (IPCC) has proved conclusively that atmospheric greenhouse gas increase is responsible for global warming.

The generation of electricity from Renewable Energy (RE) sources produces no harmful emissions. A considerable proportion of existing electricity supply from fossil fuel based power stations could be replaced with RE generated electricity, with an associated decrease in CO_2 emissions. For example, if Ireland were to target 500 MW of new RE capacity by the year 2005, this would result in an annual reduction of approximately 1.6 million tonnes of CO_2 emissions.

EU Position

The European Union set an objective of a 15% CO_2 emissions reduction, as a negotiating position on climate change for the December 1997 Kyoto conference.

The EU adopted a Green Paper on a Renewable Energy strategy for Europe on the 20th November, 1996, and published their White Paper in 1997. The strategy sets a target of 12% as a contribution from RE sources to gross inland energy consumption within the EU by 2010. This is an ambitious target, considering that, at present, the Renewable Energy sources contribution is only 6%.

The document also assesses potential job creation in the RE sector at 910,000 new jobs, with annual savings of 3 billion ECU in imported fuels also predicted.

WIND FARM DESCRIPTION

In general, a wind farm consists of a number a wind turbines, together with associated access tracks, electrical cabling (buried), transformers and other electrical equipment, and a control house.

Turbines for a development of this kind are typically 40 m at hub height, with three blades and a rotor diameter of around 40m. A typical turbine power output for recent wind farm developments in Ireland would be 600kW. The turbines are generally white or light grey in colour. Figure 1 shows side and front elevations of a typical three-bladed wind turbine of the type selected for this proposal.

The towers are usually metal, although they could be made of concrete. They have a ladder, usually up the inside of the tower, to allow access for maintenance. Turbine blades are often made of fibreglass, and are attached to the hub at the top of the tower; the blades together with the hub making up the rotor. In variable pitch turbines, the blades may be angled to give greater efficiency, or even turned parallel to the wind if it is too strong and the turbine has to shut down. The turbines operate by means of the wind turning the blades around the hub, with this movement driving an electric generator. The rotor must be facing into the wind for efficient operation. This is achieved by means of a yaw motor at the top of the tower. In some machines this also allows the rotor to face out of the wind should it be too strong. The generator, and a gearbox if one is used, are housed in a metal container called the nacelle, located at the top of the tower, usually behind the rotor. The electricity generated is at a low voltage, say, 690 V, and a transformer at the base of the tower is used to increase the voltage of the electricity to 10 kV or 20 kV for transmission around the site through underground cables. The transformer may be located near or in the base of the tower. In general, the electricity from each turbine will be cabled to a central point, where another transformer usually increases the voltage to 38 kV or 110 kV, for connection to the national electricity grid. In addition, a computer is used to monitor each turbine and control its operations. This makes the remote control of wind farms possible.

The wind speeds at which turbines operate vary, but the generally cut in at 2 - 4 ms^{-1}, with power production increasing up to a maximum at approximately 12 - 14 ms^{-1}, and the turbines usually cut out at wind speeds of 25 - 30 ms^{-1}. Turbines are generally designed to survive wind speeds of up to 70 ms^{-1}.

The turbines are arranged in a carefully designed array, the geometry of which is determined by taking into account the dominant wind directions, the spacing requirements established by the turbine manufacturer, the topography, and the aesthetics of the array viewed from a number of important viewpoints.

The proposed wind farm site will be accessed by existing roads, and the individual machines will be connected by a 4 m wide track, alongside which power and communication cables will be laid in a cable trench. All power will be transmitted underground to a central compound, where the wind farm will be connected to the ESB grid at 38 kV. The control compound will also contain a control house.

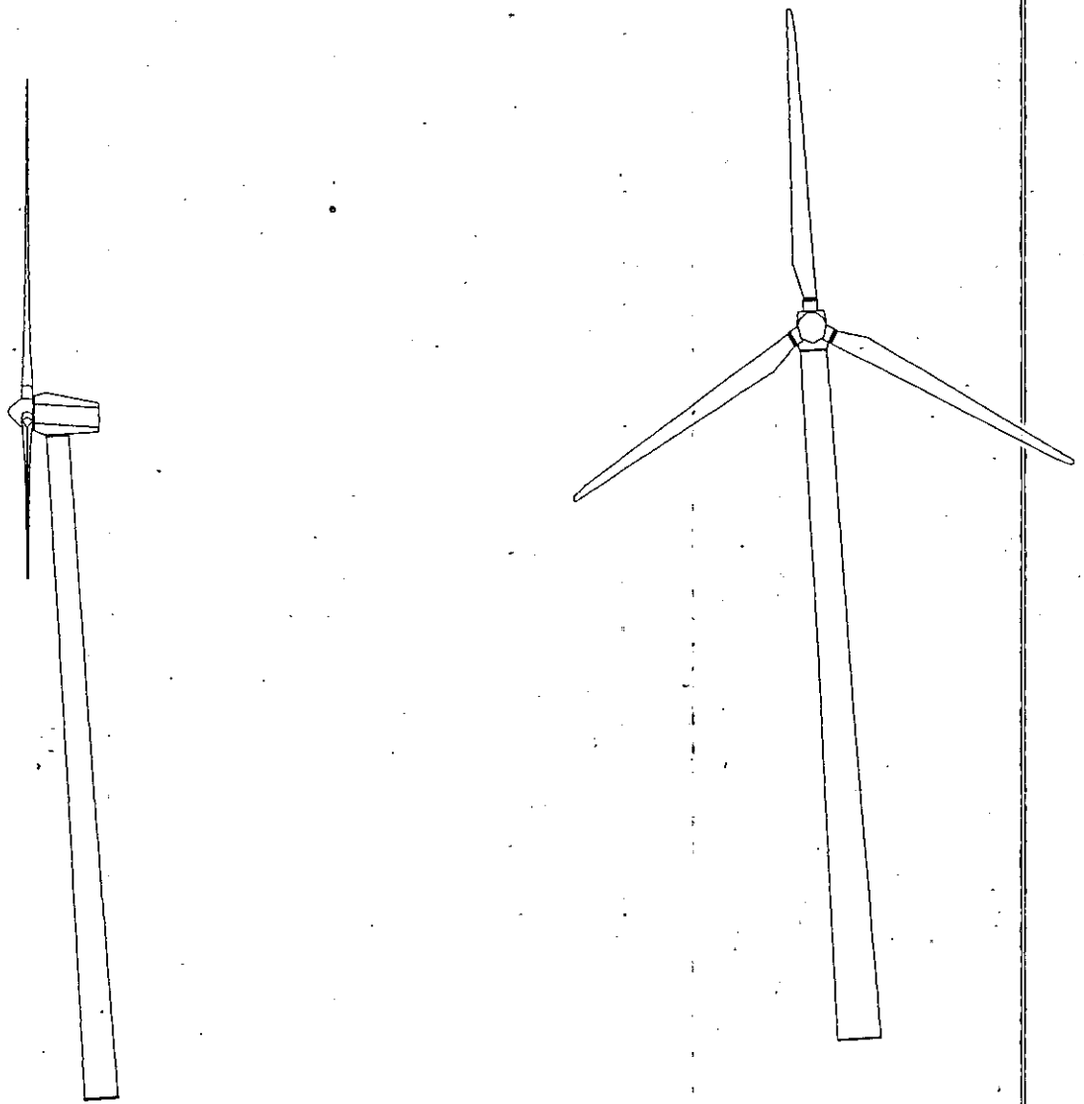


FIGURE 1 VESTAS V47 660 KW TURBINE

SCOPING OF THE EIA

The scoping of the Environmental Impact Assessment was developed in consultation with the planners in Cork County Council, and includes the following elements:

Landscape and Visual Effects
Noise
Electro- Magnetic Interference
Health and Safety
Flora
Fauna: Birds
Fauna: Mammals (with Observations on Other Fauna)
Archaeology
Material Assets (Traffic, Agriculture, Waste and Electrical Demand)
Other Environmental Impacts (Hydrology, Air and Climate, and Shadow Flicker)
Construction Impacts

NATIONAL AND LOCAL DEVELOPMENT CONTEXT

NATIONAL ENERGY POLICY

Sustainable Development - A Strategy for Ireland[2]

Published by the Department of the Environment in March this year, this document provides the most up to date view of Ireland's position with regard to sustainable energy, carbon dioxide abatement, etc. In Chapter 8 - Energy - national policy is given as follows:

"Sustainable Energy Policy:

- ensures security of supply in order to support economic and social development while protecting the environment
- maximises efficiency of generation and emphasises the use of renewable resources
- promotes energy conservation by users
- minimises emissions of greenhouse gases and other pollutants, both by clean generation and by sustainable consumption levels in all sectors
- maintains local air quality and limits and reduces the Irish contribution to regional and global environmental problems"

This document describes "An Action Programme Towards Sustainable Energy," including the introduction of new incentives to encourage investment in renewable energies. Key barriers to sustainability are identified as:

- increasing total consumption of energy, driven by strong economic growth
- a high degree of dependence on imported fuels, which raises issues of security of fuel supplies
- a high degree of dependence on fossil fuels for electricity generation, introducing concerns about continuity of supply

- increasing emissions of CO_2 from burning of fossil fuels, as well as other pollutants such as nitrogen oxides and sulphur oxides, contributing to greenhouse gases and to acid rain, among other problems
- low use of renewable energy resources

Among other approaches to these issues, including energy pricing, emission standards, and energy efficiency and conservation, renewable energy is seen as a key element in the national energy strategy, having advantages "for strategic, environmental and sustainability purposes." The document states that "in the longer term, renewable energies are the only fuel source whose continued use can be sustained. On balance, each MegaWatt (MW) of energy produced from renewable energy instead of from conventional generation reduces CO_2 emissions by an average of 1000 tonnes per annum; it also reduces oil import requirements for power generation by £100,000 per annum."

It should be noted that import substitution is only beneficial to the Irish economy when the RE resource is developed by indigenous energy companies.

AER1

The Department of Transport, Energy and Communications first Alternative Energy Requirement (AER1) was completed in 1995. This competition was designed to secure up to 75 MW of electricity generation capacity from alternative energy systems. The positive response to the scheme resulted in 34 contract offers to independent of electricity, amounting to a total electricity generation capacity of 111 MW. This included 10 wind farms, with a target of 73 MW in total.

Renewable Energy Strategy[3]

This strategy, launched in April 1996, sets out the long-term development of renewable energy. It identifies a current practicable resource of up to 800 MW of renewable energy sources, and sets out to exploit this resource. Short and medium term targets for electricity generation were established as follows:

Wind:

- an additional 90 MW of installed capacity by the end of 1999 (AER3) - bringing electricity generating capacity from renewable energy sources to 10% of total
- a further 30 MW each year for the period 2000 to 2010 - bringing electricity generating capacity from renewable energy sources to 14% of total

Programme for Government[4]

Under the government's aims for national energy policy, it is stated that the "Government will follow new approaches in energy, conserve energy across the economy, **manage EU-driven change, and aggressively pursue alternative sources of renewable energy**."

LOCAL AUTHORITY REQUIREMENTS

Local Agenda 21[5]

Agenda 21 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. 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."

Cork County Development Plan[6]

"Renewable Energy

6.23 The Council strongly supports national and international initiatives for limiting emissions of greenhouse gases and encouraging the development of renewable energy sources. The Council has taken an important step in setting up a Renewable Energy Centre in Mallow for research into, and the promotion of, renewables. It has permitted a number of small-scale hydroelectricity developments in the County and is working closely with researchers at UCC and with promoters of projects using biogas and other renewable sources.

The recently published government paper entitled "Renewable Energy - A Strategy for the Future" provides a blueprint for its development.

6.24 Wind Energy however, which is one of the technologies included in the government's alternative energy incentive scheme, has the potential to present a number of planning difficulties. While there may be potential for small, locally based projects (of less than 1 MW) on certain carefully selected sites, the potential for larger commercial windfarms is much more limited due to scale and the nature of the landscape.

6.25 There is currently a lack of data on many aspects of wind energy in the Country (e.g., wind speeds, landscape quality, visual impacts, technical feasibility, etc.) and this would preclude the proper consideration of large-scale wind farms at present. The Council will become actively involved in appropriate studies such as coastal zone management or upland management initiatives that would facilitate a detailed and integrated planning approach to windfarms. One such study into the renewable energy potential (including wind energy) of certain areas is currently being carried out under the EU APAS programme through the Council's renewable energy centre in Mallow.

6.26 Until more detailed policies in the context of the above studies are developed, therefore, the Council will be reluctant to sanction large-scale windfarm developments in the County. However, it may be possible in some secluded areas where its visual impact could be minimised, to consider larger scale proposals. In any event all proposals for wind energy development will have to show that the issues of visual impact, noise, environmental and ecological impact are satisfactorily answered by the developer. For projects larger than 1 MW, a formal EIA will be requested. There will be a presumption against windfarms in areas designated as scenic or visual amenity, in areas closed to designated scenic routes, in wilderness areas or in areas of historical, archaeological or ecological interest."

West Cork Development Plan[7]

In relation to the above, the following comments are relevant:

Part 1: Divisional Policies

This section of the Development Plan expresses concern about continuing economic and rural decline in the West Cork area, and describes the importance of attracting development. In addition, the hindrance to development of infrastructural weakness in the area is described.

The introduction of local embedded generation has a beneficial effect on the electricity infrastructure.

Part 2: Local Catchment Areas, Town and Village Plans; and Appendix V - Preservation of Amenities

The Mullaghmesha site is not located in a designated scenic area. Scenic route A81, from Kealkil, via the Cousane Gap to Togher, lies to the north of the site; scenic route A86, running between Dunmanway and Coolkellure, Castledonavan and Bantry lies to the south of the site.

CONTRIBUTION OF THE PROPOSED PROJECT TO NATIONAL AND LOCAL DEVELOPMENT POLICY

Wind energy is in an ideal position to address each of the current national energy requirements. These include:

- strengthening security of supply
- obtaining energy supplies from indigenous sources
- diversification of energy sources
- reduction of environmental damage due to electricity production
- provision for an increasing energy demand
- contributing to the objectives of the national CO_2 abatement strategy
- contributing to the EU targets set out in the Altener programme

In fact, the development of renewable energy is particularly singled out, as quoted earlier from several government documents, as being one of the primary approaches in dealing with these issues.

With regard to local development policy, the main impacts of the proposed project are socio-economic and environmental. The socio-economic contribution of the development is very positive, and it is estimated that up to £1.5 million will be contributed to the local economy over the construction period. It is the policy of Green Power Ltd, and of South Western Services, to source materials and equipment locally whenever this is possible. The construction of Mullaghmesha Wind Farm makes a strong contribution to the local electrical infrastructure, paving the way for any potential high energy use industry in the area. Environmentally, the project reduces pollution loads, and adds significantly to local sustainable development goals, as required by Local Agenda 21. Ecologically, wind power is exceptionally benign. The environmental impact of greatest concern is visual impact. This is confined to a limited area, and does not seriously impinge on designated scenic areas or routes. This is considered in detail in the Visual Impact section of the Environmental Report.

PROPOSAL

The proposed development (see figure 4) is for 20 x 600 kW (either Bonus or Nordex Balke - Dürr - locations 1 to 20) or, 18 x 660 kW (Vestas - locations 1 - 18), or 16 x 750 kW (NEG Micon - locations 1 - 16) machines at the Mullaghmesha site. The final decision on turbine selection will be based on technical and financial considerations. On-site access tracks, cable trenches, and drainage works will be required, as well as a compound containing a control house, ESB switch-gear, etc.

THE SITE AND ITS SURROUNDS

Site Location

Mullaghmesha Mountain is located near Castledonavan, Drimoleague, Co. Cork, between Dunmanway and Bantry (see figure 2: Site Location Map).

Existing Land Use

The land at the site is poor, and is used exclusively for rough sheep grazing and turf-cutting.

Topography

Mullaghmesha lies in an upland area south of the Shehy Mountains. This area also includes the Maughanaclea Hills, Nowen Hill, and Derreenacrinnig West. The site itself is an upland moor in character. The terrain is gentle to moderately undulating. Mullaghmesha is steeply flanked in all directions except to the south, where the landform is rolling. Two adjoining small lakes, Coomanore Lough and Lough Agower are situated directly to the south west of the peak of Mullahgmesha. The Little Mealagh River (a tributary of the Mealagh River) has its source on the north western flank of the site; tributaries to the Little Mealagh River have their source on the western and north western flanks of the site. The River Ilen some of its tributaries have their sources on the eastern, north eastern, and south eastern flanks of the site.

Site Access

Access roads to a number of well worked upland turf cutting sites exist to the west, south west, and south east of the site, as may be seen from figure 3. Construction traffic access from Dunmanway is via Castledonavan, on the route indicated in figure 3.

Site Services

Other than the three access roads, no other services exist at the site.

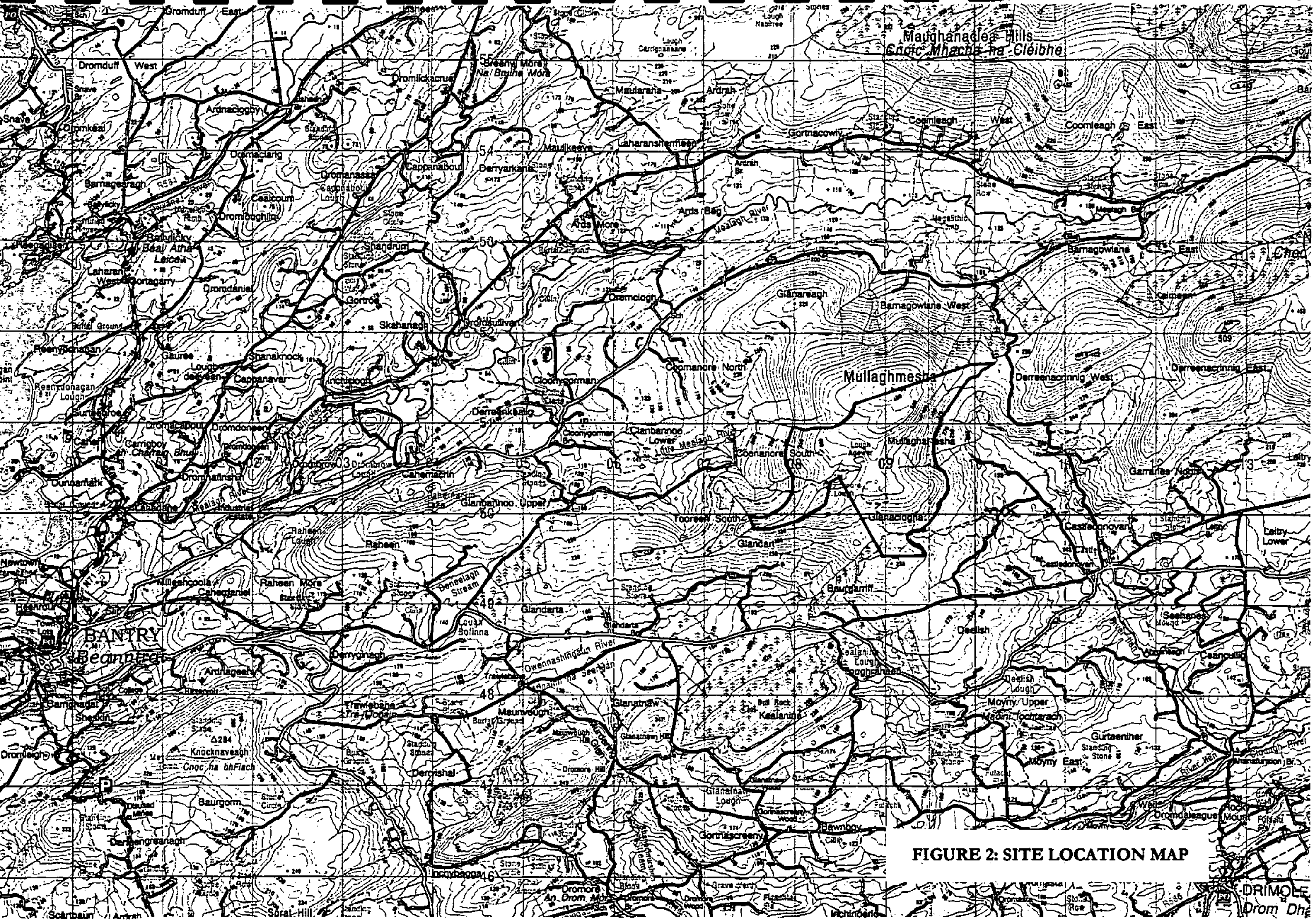


FIGURE 2: SITE LOCATION MAP

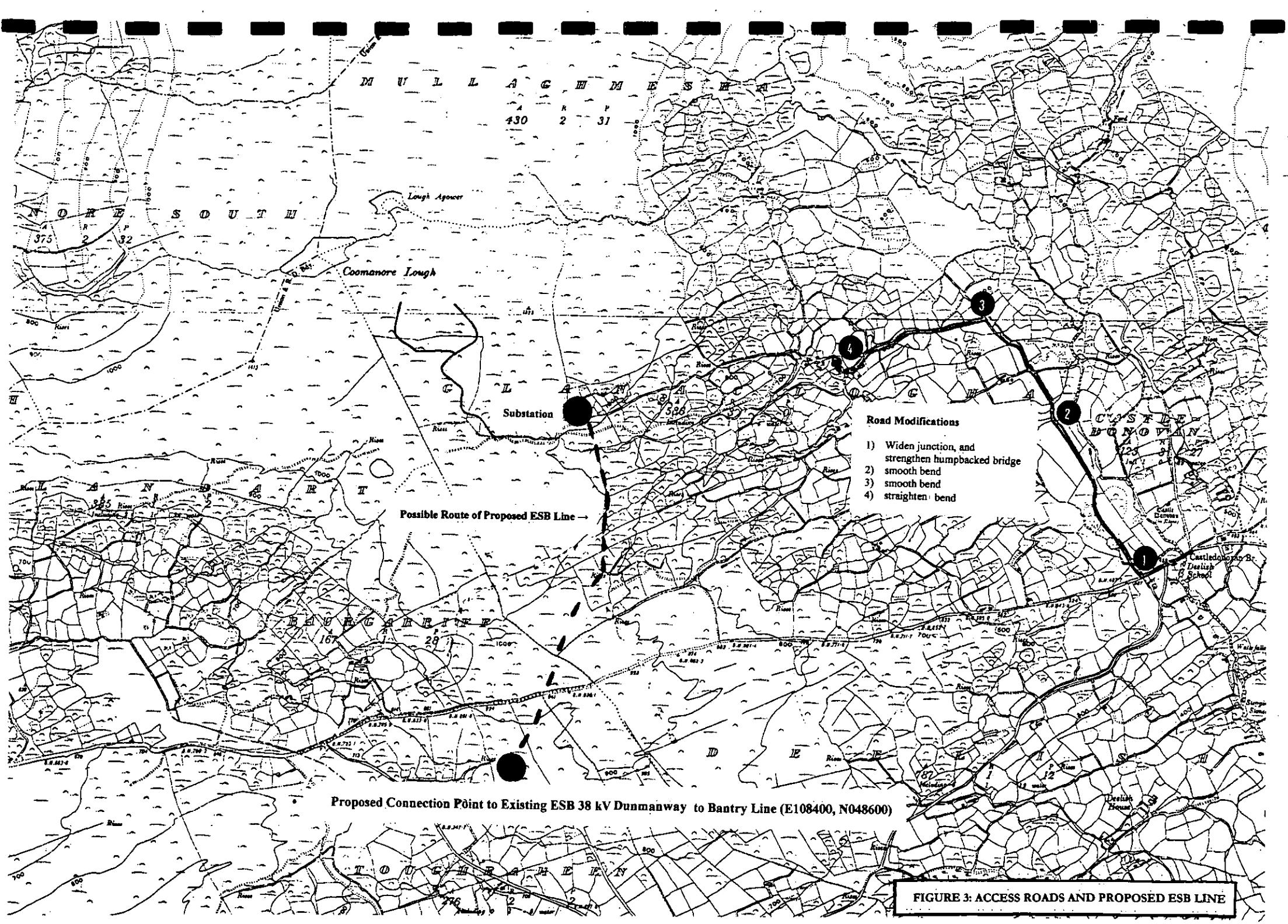


FIGURE 3: ACCESS ROADS AND PROPOSED ESB LINE

CONSTRUCTION

There are three main elements in this development (see figures 4 to 7). These are:

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

  ◊ *access roads* will require modifications as shown in figure 3. This will include widening of the junction (1) and strengthening of the humpbacked bridge (1); smoothing of bends (2) and (3); and the straightening of the road (4).

  ◊ *site roads* will be required to connect the turbines and the control house to the access roads, which already exist. These will be 3.5 - 4.0 metres wide, and will be constructed in the style of the farm tracks leading to the site. Any embankment material required would be drawn from excavated material where it is structurally suitable; other stone can be acquired from within the site. A site investigation has shown an abundance of suitable gravel material for fill, etc.

  ◊ *drainage* will be required for the site roads, due to the wet ground conditions, as well as for each turbine, and for the control house.

  ◊ *foundations* for the turbines will be constructed of reinforced concrete. They are likely to be of the order of 9 m x 9 m x 1.5 m in size, although the exact specifications may change, depending on the results of a more detailed site investigation.

- **erection of the turbines:** A mobile crane will be required for the erection of the turbine elements. The tower will be securely connected to the foundation, and then erected in two or more stages. The nacelle and blades are then attached.

- **electrical works:** The generator and other turbine equipment will be installed, and connected to a 690 V to 20 kV transformer at or in the base of the turbine. Through underground cabling, these transformers will be connected to a 20 kV ring main leading to a 38 kV transformer at the control house security compound. The compound will also contain ESB switch- gear at 38 kV, and an ESB end pole. The control house will contain switch-gear and control panels. The whole compound will be surrounded either by palisade security fencing, screened by suitable hedging or trees, or by suitable natural security hedging (thorn, for example). An overhead 38 kV line will connect an end pole to the ESB 38 kV line running from Dunmanway to Bantry (see figure 3).

The construction timetable will begin when planning permission is granted. Allowing almost 6 months for the planning process, and assuming the results of the AER3 competition have been announced, and that a contract has been awarded, construction would proceed as in figure 8.

CONSTRUCTION EMPLOYMENT

Employment from the proposed wind farm will come primarily from its development and construction.

- **R&D Staff, and the Hire of Consultants for Production of EIA:** The development of this project so far has given full time employment to one person and contract work to more than twenty people.

- **Manufacture of Tower and Control System:** It is the intention of the developers that as many elements of the development as are viable be manufactured locally, or at least within the country. The control panels, and portions of the electrical works could be supplied locally.

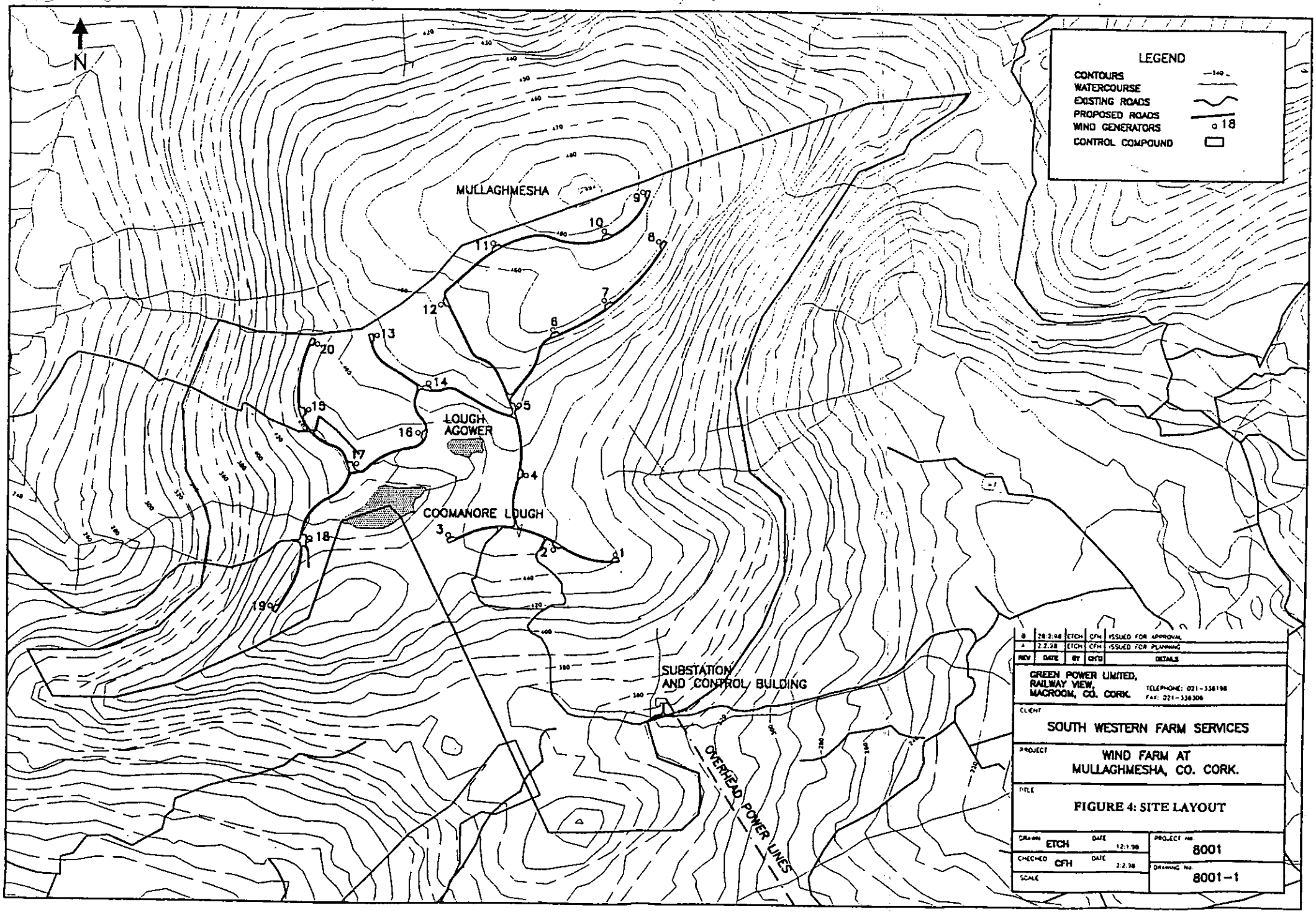
- **Construction: Roads, Foundations, Tower Assembly, Electrical Development of Site, Commissioning, etc.:** A West Cork building contractor will be engaged to carry out civil works, including the construction of site roads, laying of foundations, erection of towers, and excavation of cable trenches.
Concrete and other building materials will be sourced locally.
Plant hire will be contracted locally. There are several companies in Dunmanway, Ballinascarthy, Drimoleague and Bantry that could provide the required plant, along with the associated operatives.
The electrical consultant and contractors for this project will be from Co. Cork.
Cranes will be required for the erection of the turbines. A Cork company has been contacted in this regard.

TRAFFIC

Traffic generated by contruction is examined in the section dealing with the environmental impacts of construction.

WASTES, RESIDUES AND EMISSIONS

The construction period does give rise to some soil waste, where material is excavated for the construction of access roads and foundations; however, much of this material will be used for the reinstatement of the site after construction, as well as for construction of the access roads. Construction noise is not expected to impinge on local residents, due to the mitigating effect of distance. This is examined further in the section dealing with the environmental impacts of construction.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WATERCOURSE
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PROPOSED ROADS
WIND GENERATORS
CONTROL COMPOUND
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COOMANORE LOUGH
SUBSTATION AND CONTROL BULDING
OVERHEAD POWER LINES
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B 28.2.98 ETCH CFH ISSUED FOR APPROVAL
A 2.2.98 ETCH CFH ISSUED FOR PLANNING
REV DATE BY CHKD DETAILS
GREEN POWER LIMITED, RAILWAY VIEW, MACROOM, CO. CORK.
TELEPHONE: 021-336198
Fax: 021-336306
CLIENT
SOUTH WESTERN FARM SERVICES
PROJECT
WIND FARM AT MULLAGHMESHA, CO. CORK.
TITLE
FIGURE 4: SITE LAYOUT
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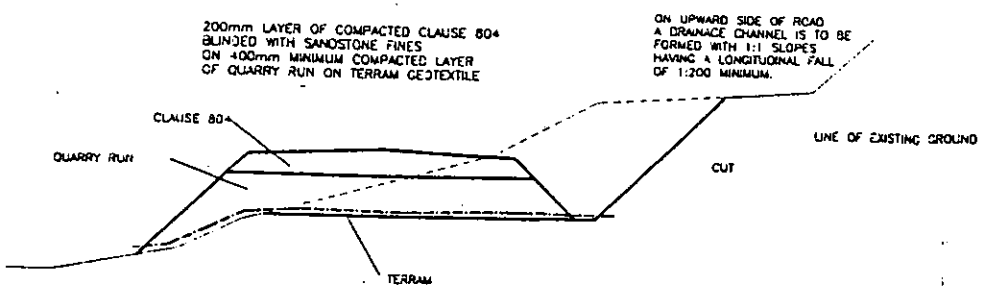
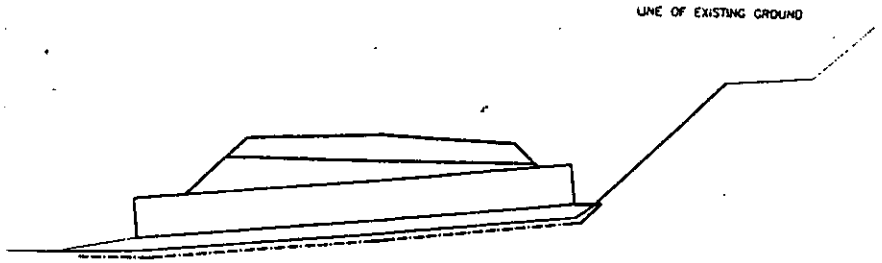
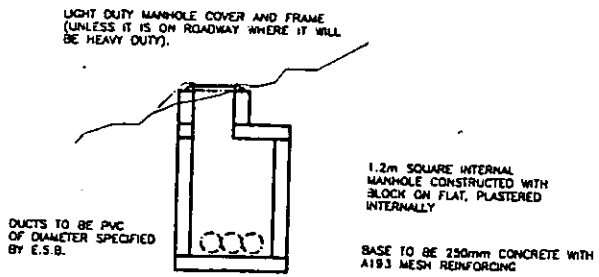
CHECKED CFH DATE 2.2.98
SCALE
PROJECT No. 8001
DRAWING No. 8001-1



TYPICAL ROAD CROSS SECTION



TYPICAL ROAD CULVERT SECTION



TYPICAL DUCT MANHOLE SECTION

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A	2.2.98	ETCH	CFH	ISSUED FOR PLANNING

GREEN POWER LIMITED,
RAILWAY VIEW,
MACROOM, CO. CORK.
TELEPHONE: 021-338198
FAX: 021-338304

CLIENT: SOUTH WESTERN FARM SERVICES

PROJECT: WIND FARM AT MULLAGHMESHA, CO. CORK.

TITLE: TYPICAL SECTIONS

DRAWN	ETCH	DATE 12.1.98	PROJECT No. 8001
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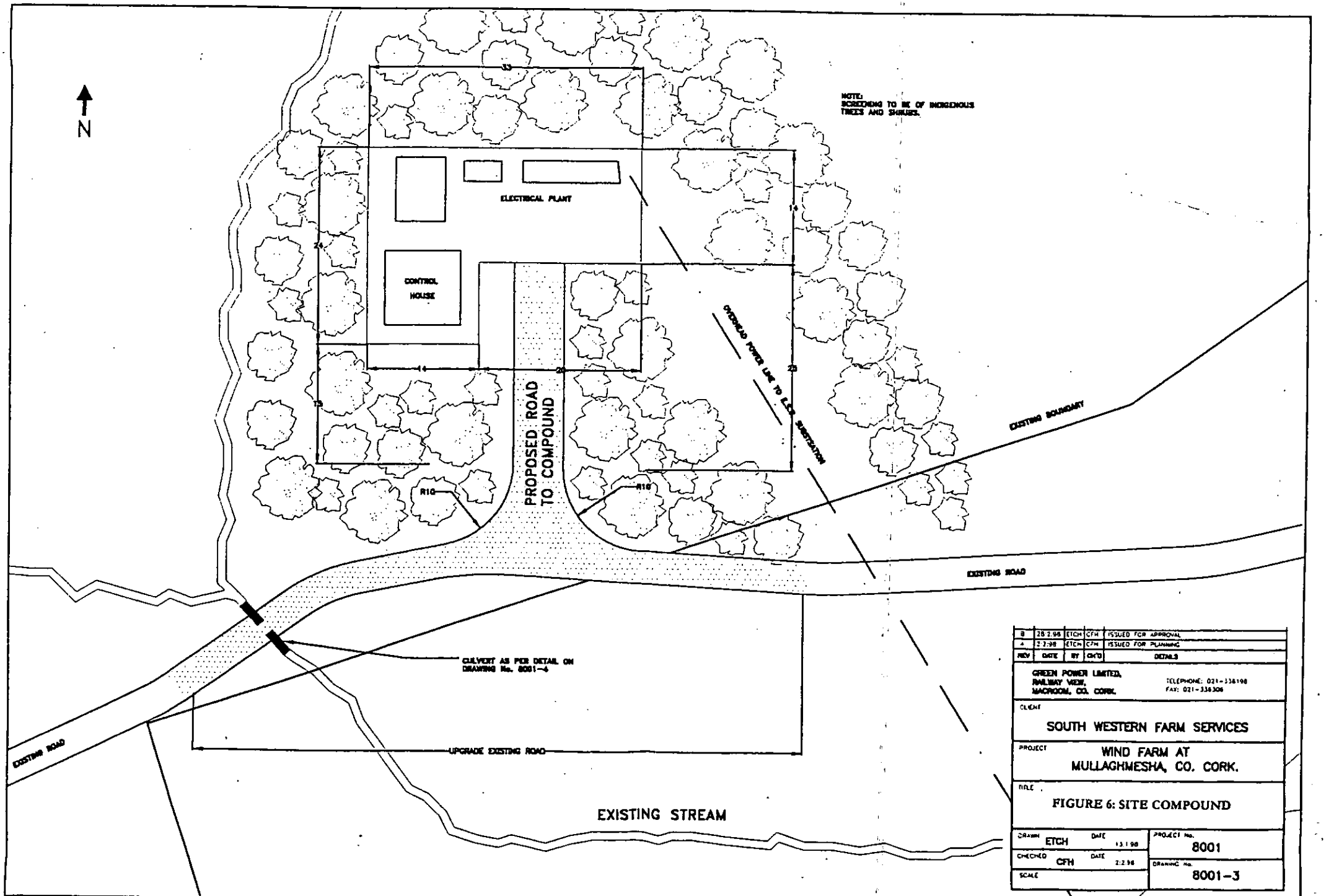
SCALE			

FIGURE 5: ROAD CONSTRUCTION AND DRAINAGE DETAIL



REV	DATE	BY	CK'D	DETAILS
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A	2.2.98	ETCH	CFH	ISSUED FOR PLANNING

GREEN POWER LIMITED,
RAILWAY VIEW,
MACROOM, CO. CORK.
TELEPHONE: 021-336198
FAX: 021-336306

CLIENT
SOUTH WESTERN FARM SERVICES

PROJECT
WIND FARM AT
MULLAGHMESHA, CO. CORK.

TITLE
FIGURE 6: SITE COMPOUND

DRAWN ETCH	DATE 13.1.98	PROJECT No. 8001	
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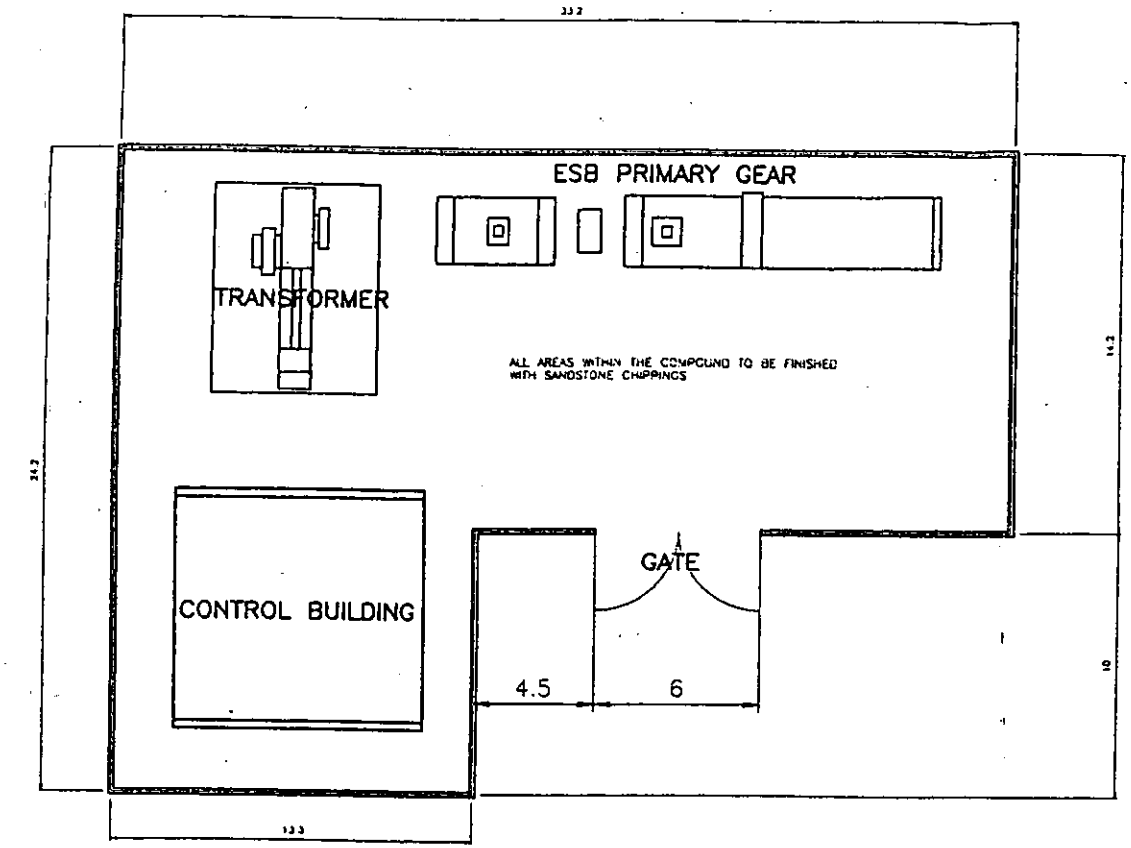
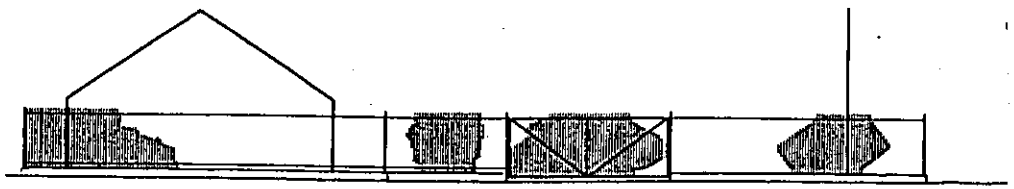
SCALE			



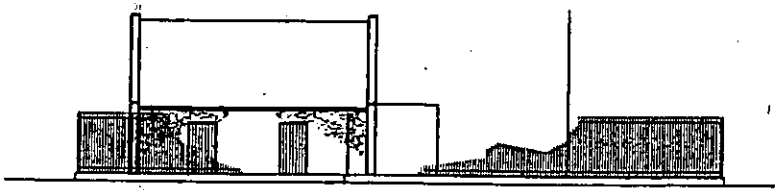
2M WIDE FOOTPATH ALL AROUND THE CONTROL BUILDING.
PRECAST CONCRETE PAVING SLABS ON 50mm SAND/CEMENT BASE

PLAN OF COMPOUND
1:100



SOUTH ELEVATION
1:100

NOTES:
FENCING TO BE 2.4m HIGH PALLISADE GREEN PLASTIC COATED GALVANISED STEEL BY IRISH FENCING OR APPROVED EQUIVALENT
ALL AREAS TO BE STONED WITH SANDSTONE CHIPPINGS.
GATES TO BE SIMILAR TO FENCING AND TO BE LOCKABLE.



WEST ELEVATION
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REV	DATE	BY	CHKD	DETAILS
B	28.2.98	ETCH	CFH	ISSUED FOR APPROVAL
A	2.2.98	ETCH	CFH	ISSUED FOR PLANNING

GREEN POWER LIMITED,
RAILWAY VIEW,
MACROOM, CO. CORK.
TELEPHONE: 021-336196
Fax: 021-336306

CLIENT: SOUTH WESTERN FARM SERVICES

PROJECT: WIND FARM AT MULLAGHMESHA, CO. CORK.

TITLE: PROPOSED CONTROL BUILDING AND ELECTRICAL COMPOUND

DRAWN	ETCH	DATE 12.1.98	PROJECT No. 8001
CHECKED	CFH	DATE 2.2.98	DRAWING No. 8001-4
SCALE			

FIGURE 7: CONTROL BUILDING AND ELECTRICAL GEAR

ID	Task Name	Duratic	Start	Finish
1	Planning Application	24ew	Thu 26/03/9E	Thu 10/09/9E
2	PPA Offers	0d	Thu 30/04/9E	Thu 30/04/9E
3	Detailed Design	13ew	Thu 10/09/9E	Thu 10/12/9E
4	**manufacturing and delivery**	**199d**	**Thu 10/12/98**	**Thu 12/08/99**
5	manufacturing	28ew	Thu 10/12/9E	Thu 24/06/9E
6	delivery	7ew	Thu 24/06/9E	Thu 12/08/9E
7	**site works (civil & electrical)**	**102d**	**Thu 01/07/99**	**Fri 29/10/99**
8	access roads	6ew	Thu 01/07/9E	Thu 12/08/9E
9	foundations	12ew	Thu 29/07/9E	Thu 21/10/9E
10	transmission cables	6ew	Thu 08/07/9E	Thu 19/08/9E
11	installation of turbines	20d	Wed 06/10/9E	Fri 29/10/99
12	commissioning	9ew	Fri 29/10/99	Fri 31/12/99
13	commercial operation	0d	Fri 31/12/99	Fri 31/12/99
14				
15				
16				
17				

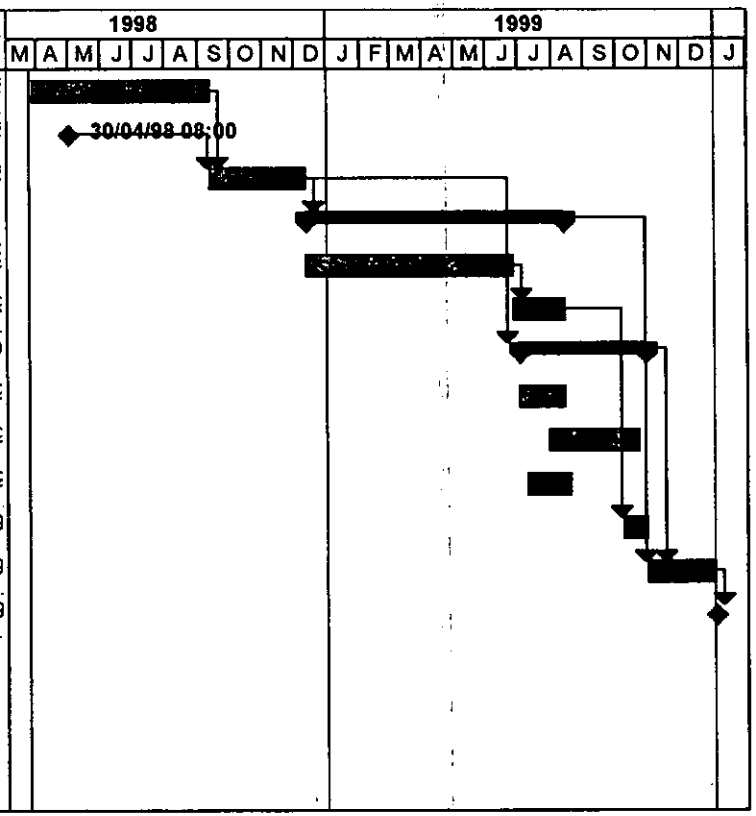


FIGURE 8: CONSTRUCTION TIMETABLE

OPERATION

EMPLOYMENT

The operation of the wind farm will make a modest contribution to local employment, with 2 to 3 people likely to be engaged in management, operation and maintenance.

TRAFFIC

Operation of the wind farm is expected to generate 1 to 2 trips per day in a light vehicle for routine operation and maintenance, as well as occasional trips by a crane for major repairs, which are not expected to be frequent. It is considered that the impact of this number of trips is negligible.

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.

ALTERNATIVES CONSIDERED

Green Power Ltd has been prospecting for wind farm sites in the South West of Ireland for the past 5 years. Sites have been investigated in a wide variety of locations in counties Cork, Kerry and Clare.

There are number of factors that influence the choice of site selection, including as follows:

SITE SELECTION CRITERIA

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 expense of cabling generated electricity to the national electricity grid is such that unless the proposed site is in close proximity to either a 38 kV line, a 110 kV 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 a likelihood of wind speeds appropriate for the 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 found. High wind speeds are necessary to ensure energy yields that render the development economically viable within the AER III competitive bidding process introduced by the Department of Public Enterprise.

Planning Designation: Having effectively excluded inland sites of low elevation, as well as those upland and coastal sites too far from the National Grid, it is then not considered worthwhile to investigate areas designated as scenic (which very often coincide with the upland or coastal areas where high wind speeds are to be found). These are considered inappropriate.

Thus, by a lengthy process of elimination, suitable sites for study are identified.

Accessibility: Of those upland and coastal areas that are close to the National Grid and not designated discouragingly for conservation, those that are too inaccessible must be ruled out. 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.

Electro-Magnetic Interference: Being restricted in site choice as described, it is then necessary to ascertain the level of telecommunications in the area.

All of these factors significantly limit the number of potential wind farm sites. From the residual suitable locations, sites where other developers are investigating can be discounted; then the agreement of landowners must be sought. Finally, having secured planning permission, a monitoring mast is installed. It then remains to be seen whether the wind speeds are actually appropriate, whether excessive turbulence rules the site out, etc.

Clearly, even to arrive at the stage of choosing a site for development, many sites will already have been assessed and discarded. However, of those sites that were examined and thought to have potential, the following were seriously considered:

ALTERNATIVE SITES

Glenlough, Canshanavoe, Adrigole, Co. Cork

This site was found to be suitable in many respects. Monitored wind speeds appeared suitable. The site is not in designated as a scenic area for planning. There is a single landowner who was very co-operative. The terrain is relatively level at the top. However, the access road is very poor, and extensive modifications would have to be carried out to it before development could take place. It was then discovered that the section of the National Grid near this site was weaker than first appeared to be the case, and a smaller wind farm than first envisaged would have to be considered. The cost of the access road modifications then became prohibitive. A strengthening of the National Grid in this area in the future could make this site viable once more.

Borlin Valley, Co. Cork

This site was thoroughly investigated. However, extensive monitoring showed that turbulence at this site is excessive, making it unsuitable for a wind farm development.

Mullaghmesha, Drimoleague, Co. Cork

This site was found to be most suitable in many ways. It is not in an area designated as scenic for planning. Monitored wind speeds are excellent. There is considerable space available for development on a large plateau area. There is excellent access, with three roads leading up into the site. The 38 kV line is within 1 km of the site. The landowners are very co-operative, and agreements have been signed as necessary.

Derreenacrinnig West, Drimoleague, Co. Cork

An investigation of this site has begun, but it is not yet known if it will prove suitable. It offers many of the same advantages as Mullaghmesha, except that it is not so near the 38 kV line, but is far more limited in terms of land area available.

Knockbrack, Kilgarvan, Co. Kerry

This site was found to be promising in many ways. The elevation of the site is good, and it is relatively exposed to the predominant wind direction from the South West. The ESB substation in Kilgarvan is nearby, giving access to the National Grid. There are no telecommunications sites nearby. There is a good access road going almost to the top of the site. The terrain is relatively level along the ridge, on which lies a fairly big plateau, running roughly from North to South. However, that ridge marks the boundary between an undesignated area to the East, and an area

designated as having secondary scenic importance to the West. The effect of the latter designation on a planning application is unclear. Until this is clarified, the suitability of this site remains in doubt.

Carran, Kilgarvan, Co. Kerry

Located across the valley from Knockbrack - that valley being the one designated as a secondary scenic area - it is a similar site in some respects. The Kilgarvan ESB substation is not far. There are no telecommunications sites nearby. However, the elevation is far higher, which is likely to lead to significantly higher wind speeds. On the other hand, it does not have the same advantages as Knockbrack in terms of accessibility or suitability of terrain. Carran is very steep in places, and access roads do not climb much higher than the foot of the mountain. The overall suitability of this site also remains indeterminate due to the designation of the West side of the site.

Gullaba, Kilgarvan, Co. Kerry

This is the third of the alternative sites considered for connection to the Kilgarvan ESB substation. There are no telecommunications sites nearby. The elevation is as high as that of Carran, and even higher towards the South, at Gortacreenteen. However, it is also even more limited than Carran in terms of terrain, and has an equal lack of accessibility. Gullaba lies to the South of the valley designated as being of secondary scenic importance, and for this reason the suitability of the site is unclear.

Ballybunion, Co. Kerry

Monitoring has been carried out at this site for some time now, and the examination of the site is nearing completion. The site does not lie in an area of designated scenic importance. The ESB has identified a need for a limited contribution to the National Grid in this area. There are telecommunications masts in the locality, but these are not close enough to be of great concern. There is one landowner, who is very co-operative. This site may be suitable for a smaller development.

ALTERNATIVE TURBINE DESIGN[8,9,10,11,12,13,14]

The final decision on turbine manufacturer has not been made, but four have been shortlisted. These are: BONUS Energy A/S, NEG/Micon A/S, Nordex Balcke-Dürr GmbH, and Vestas – Danish Wind Technology A/S. These are four of the largest and most reliable turbine manufacturers worldwide. Their turbines are very similar in terms of appearance and performance.

Towers may be untapered, tapered gradually, or tapered in stages. It is recommended that they be tapered gradually. Towers may be latticed, tripod or tubular. Tubular towers are recommended for landscapes in Britain and Ireland. Tubular towers may be cylindrical or polygonal. It is recommended that they be cylindrical.

Nacelles should appear in proportion to the tower in shape and size. This is generally found to be the case with most European turbines.

Wind turbines may be 1-, 2-, or 3-bladed. It is recommended that 3 blades be used, for visual balance. The blades on each machine should rotate in the same direction as the others. Where the wind is not strong enough to generate electricity, the blades should be allowed to turn in the wind rather than being stopped, to avoid giving an appearance of redundancy.

The wind turbines should all have a similar appearance, and be the same colour. Previously, off-white or grey were considered the most suitable colours for Britain and Ireland, being best able to blend against the sky. More recent opinion suggests that attempts to disguise turbines are too obvious and are bound to fail, while a white colour makes the turbines look more sculptural. The

developers are happy to accept the opinion of the planners on this issue. The paint used can be glossy or matt, but a non-reflective surface with matt paint is recommended.

ALTERNATIVE SITE LAYOUTS

The layout of the turbines is an important element in ascertaining the level of visual impact of a wind farm. "The turbine or an array of turbines will dominate the field of vision to a distance of about 10 times the turbine's height. The zone of "visibility" where the turbines can be seen but become part of the distant landscape extends to a distance of 400 times the turbine's height. Although visible, they may not be visually intrusive."[15]

" How we view wind turbines on a landscape, whether in the foreground or on a distant mountainside, strongly reflects our desire for visual "tidiness," a result of our need to create order out of chaos...Maintaining order and visual unity is the single most important means to lessening the visual impact of turbine array...The arrays should have uniform density and spacing."[16]

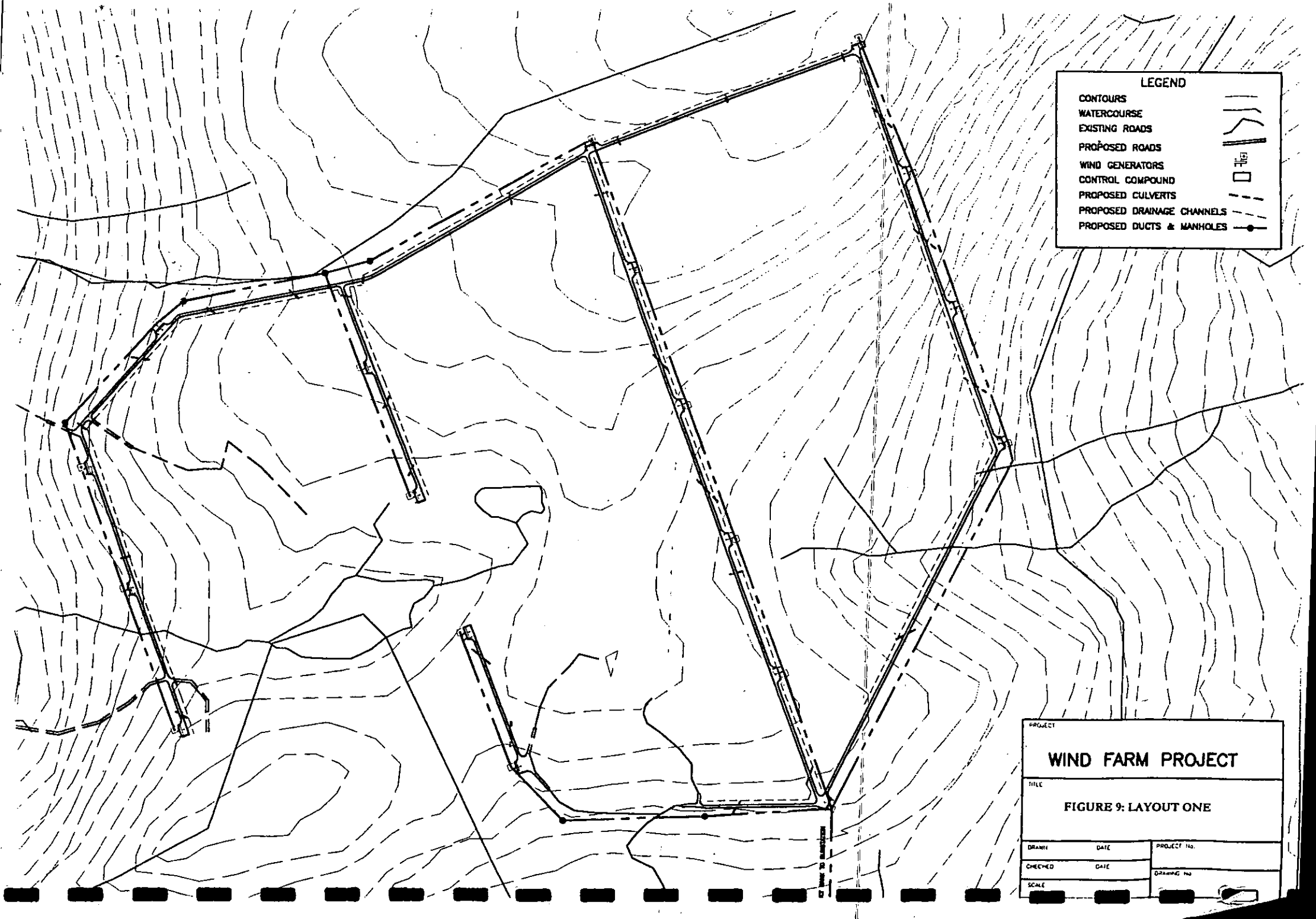
For this reason, three turbine layouts were investigated, as shown in figures 9, 10, and 11. These are examined in more detail in the Visual Impact section of the Environmental Report.

Another option is to use fewer, larger machines. For example, 12 x 1500 kW machines could be used instead of the proposed 18 x 660 kW machines, giving the same maximum power output. However, the machines currently most suitable for the Irish wind climate are those in the 600 kW - 750 kW range.

Other than the layout and number of the turbines, there is much that can be done with the rest of the site layout to minimise any effects on the environment. Security fencing is not generally required. The site may continue to be used exactly as it always has been prior to the development. All power lines within the site will be buried, reducing visual clutter. The control panels for each turbine will be contained within the towers. Depending on the turbine, the transformer at the base of each tower may be incorporated into the tower. If not, then an earth mound can be built up around the base of the tower, screening the transformer. The control house will be faced with local stone. The control house and ESB primary switch-gear are to be located well below the line of the horizon, and screened with suitable hedging or trees. Where cabling leaves the site to join the ESB 38 kV line, it will follow natural field and road boundaries.

Three separate access roads lead to the site, so that the only road construction necessary will be the on-site tracks, which can be constructed in a similar style to existing farm tracks. They will be restricted to 3.5m - 4m in width. The site tracks will follow contours where possible, as shown previously in the site maps. Any excavated areas necessary for their construction will be reinstated, re-covering all earth banks with the natural vegetation of the site. This will also reduce any possible erosion. In any event, the terrain of the site is essentially that of a plateau, and is not steep. Erosion is unlikely to be a major concern.

Simple tidiness in the operation of the development is also important where visual impact is significant. Care taken with the use of oils and lubricants is part of this; vehicles will be refuelled off-site.


LEGEND
CONTOURS
WATERCOURSE
EXISTING ROADS
PROPOSED ROADS
WIND GENERATORS
CONTROL COMPOUND
PROPOSED CULVERTS
PROPOSED DRAINAGE CHANNELS
PROPOSED DUCTS & MANHOLES
PROJECT
WIND FARM PROJECT
TITLE
FIGURE 9: LAYOUT ONE
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PROJECT No.
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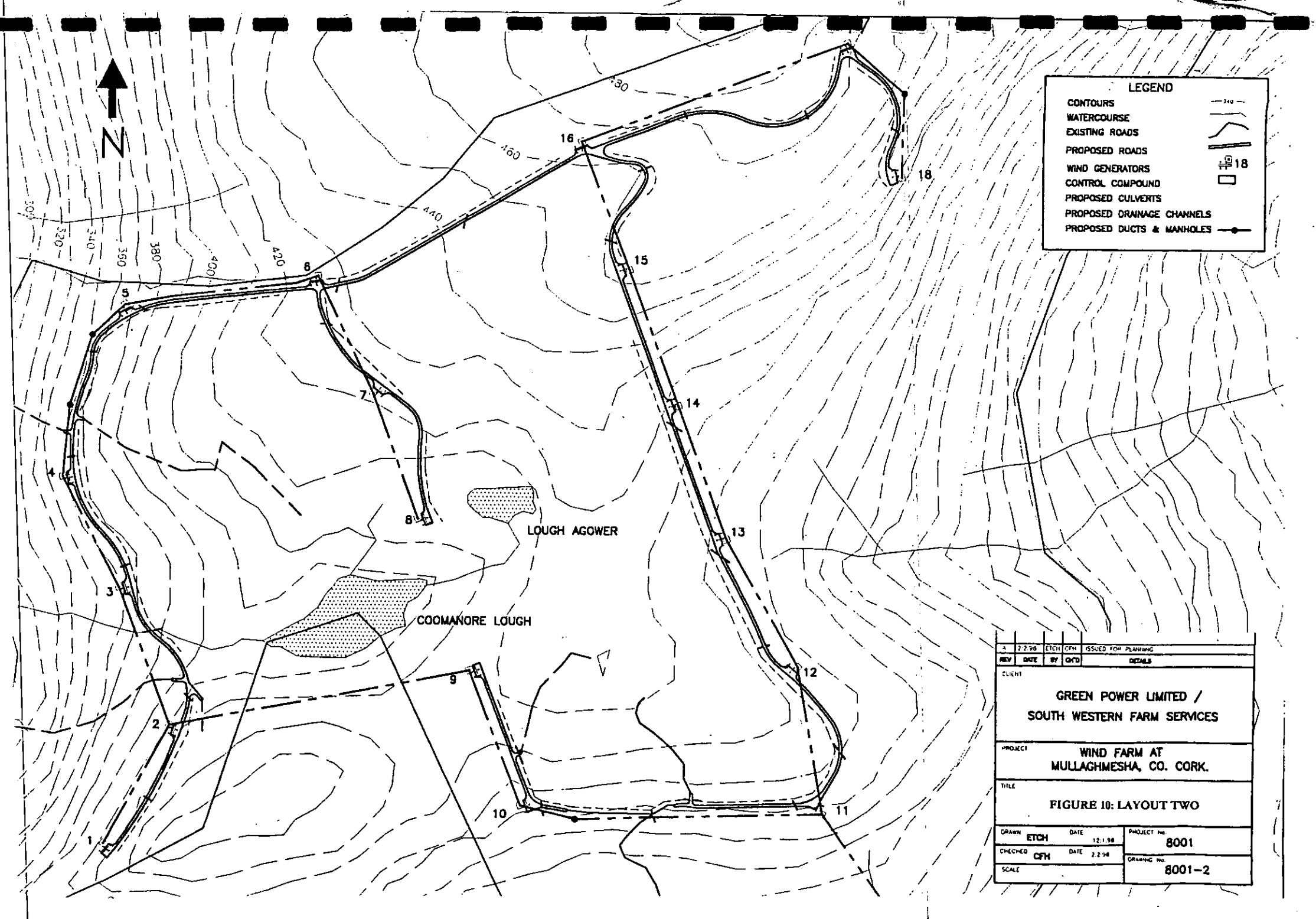
DRAWING No.
SCALE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CLIENT
GREEN POWER LIMITED / SOUTH WESTERN FARM SERVICES
PROJECT
WIND FARM AT MULLAGHMESHA, CO. CORK.
TITLE
FIGURE 10: LAYOUT TWO
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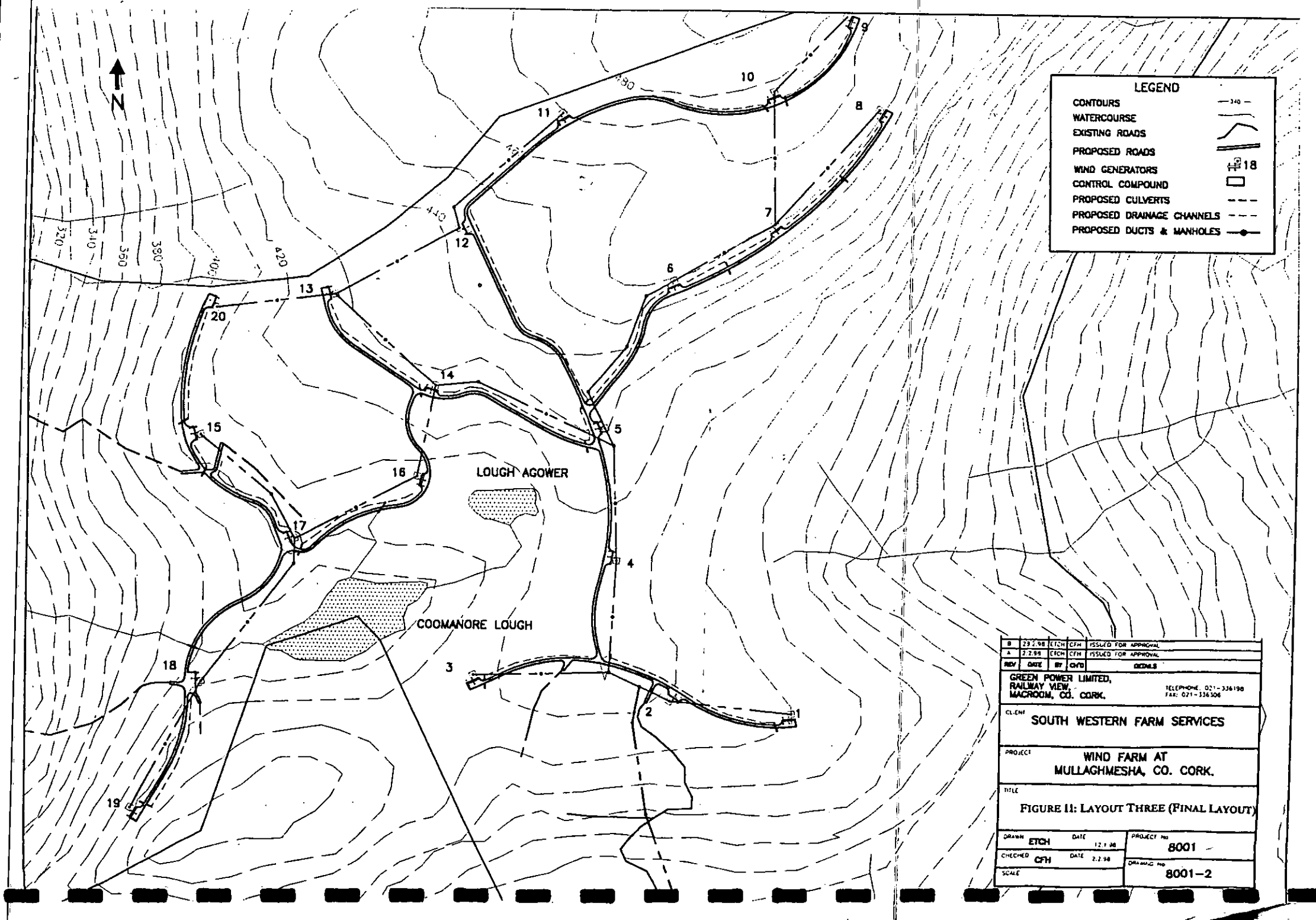
CHECKED CFH DATE 2.2.98
SCALE
PROJECT No. 8001
DRAWING No. 8001-2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A 2.2.98 ETCH CFH ISSUED FOR APPROVAL
REV DATE BY CH'D DETAILS
GREEN POWER LIMITED,
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PROJECT
WIND FARM AT
MULLAGHMESHA, CO. CORK.
TITLE
FIGURE 11: LAYOUT THREE (FINAL LAYOUT)
DRAWN ETCH DATE 12.1.98
CHECKED CFH DATE 2.2.98
SCALE
PROJECT No 8001
DRAWING No 8001-2

SPECIFIED INFORMATION AND FORECASTING METHODS

MONITORING

The Mullaghmesha site has been monitored for just under one year. A 30 m guyed tubular mast is on site, with an anemometer and a wind vane at both 20 m and 30 m. An NRG 9300 Stand Alone Logger, capable of recording at 1 minute intervals, is being used. All of the equipment used is manufactured by NRG Systems, Inc., Vermont, USA. A hand held Term Reader is used for examining and programming the logger, and for downloading data from datacards to a PC. This information is downloaded in both binary and ASCII formats. The binary formatted files can be used as input for a variety of software applications; the ASCII files may be used for statistical analysis, and other uses.

ANALYSIS

Wind data was analysed using:

NRG MicroSite: this software allows a thorough analysis of the input data, but allows neither physical nor time-based extrapolation of the results.

WA^{S}P: produces a good analysis of the input data, and allows physical extrapolation of the results, within certain limits which should be thoroughly understood by the analyst; it does not provide a time-based extrapolation.

The Measure-Correlate-Predict (MCP) Method: this is a statistical procedure whereby measured data at the short term measurement site is correlated with data in the same time-frame from a long term (reference) site, e.g., a meteorological station. A relationship is derived between the two sets of data. Then, this relationship is inversely applied to long term data at the reference site (say, for a 30-year run of data), resulting in a prediction of long term data at the measurement site.

Clearly, each of these methods has its strengths and limitations, but by using three independent means of analysis, a reasonable long term data prediction can be made.

A summary of results from wind monitoring and analysis have been given to Cork County Council in confidence.

CERTIFICATION OF TURBINES

Turbine structural safety, electro-magnetic emissions, sound power levels, etc., are certified by independent certification bodies, e.g., Risø (Denmark), Acoustica A/S (Denmark), ECN (The Netherlands), and Germanischer Lloyd (Germany). This has been dealt with in greater detail in the section on Health and Safety. Other information courtesy of manufacturers, and based on their operational experience, but not certified, is also included.

ENVIRONMENTAL REPORT

CONTRIBUTORS

UCC, Cork

Department of Civil & Environmental Engineering
Dr Donncha Ó Cinnéide, Traffic Research Unit

Dr Donncha Ó Cinnéide, B.E., M.Eng.Sc., PhD., C.Eng., is a Statutory Lecturer in Civil Engineering and Head of the Traffic Research Unit at University College Cork. Previously Dean of Engineering at University College Cork and Research Officer with An Foras Forbartha, Dublin. He has published many papers on transportation and on environmental noise and has been involved in the measurement and in the evaluation of environmental noise from a substantial number of both industrial and infrastructural development proposals.

Department of Electrical Engineering and Microelectronics
Mr Aidan Murphy, Teltec Ireland

Aidan Murphy received a BE degree from UCC in 1983 and an MEng Sc in 1985 for research in the area of microwave electronics. From 1985 to 1987 he worked as a research assistant in the Microwave Laboratory, UCC. In 1987 he joined Pacific Monolithics, Sunnyvale, CA, as a microwave engineer specialising in GaAs microwave device characterisation and test. He returned to Ireland in 1989 to join Hormann Electronics, where among other things he worked on the development of MMDS products. In 1992, he was appointed as a senior research engineer with Teltec Ireland in UCC. In this capacity he has been involved in many aspects relating to the planning process associated with the development of high frequency transmission systems. He is a member of the Institute of Electrical and Electronic Engineers (IEEE), the IEEE Microwave Theory and Techniques Society, and the IEEE Consumer Electronics Society.

Aquatic Services Unit
Manager:

Mr Ger Morgan

Scientific Staff:

Dr Paul M. Walsh

Dr. P.M. Walsh has extensive experience of surveying terrestrial, marine and freshwater birds in Ireland and Britain, for nationally organised projects and Environmental Impact Assessments. His particular areas of research expertise include forestry and birds; population and breeding ecology of seabirds; feeding ecology of owls; heavy metals in vertebrates; ecology and conservation of birds in general; status of Irish birds.

Brief Educational History: 1980-85 Department of Zoology, University College, Cork. 1984, BSc (Hons) conferred. 1985, MSc. Conferred; title of thesis: 'Avian, osteometric and seasonal aspects of barn owl Tyto alba prey in southern Ireland.' 1986-89 Department of Zoology, University of Glasgow, 1993 PhD conferred; title of thesis: 'Northern gannets Morus bassanus as indicators of mercury levels in the marine environment.' Employment: July 1995-present Research Scientist, COFORD Biodiversity Project, Department of Zoology & Animal Ecology, University College, Cork.

Mr. Tony O'Mahony

Mr. T. O'Mahony is the joint County Botanical Recorder for County Cork and one of Ireland's leading botanists. He is a nationally and internationally recognised authority on sedges and sedge hybrids and has contributed to several publications on the subject. He is also an expert on Irish wild roses. Mr. O'Mahony has extensive experience of Environmental Impact Studies having undertaken the botanical inputs for the following EIS's in recent years: Road Schemes (Glounthane By-Pass, Watergrasshill-Rathcormack By-Pass, Ashford By-Pass, Youghal By-Pass – with PRS). OPW Flood Relief Schemes at Kilkenny (River Nore), Carlow (River Barrow), Dunmanway (River Bandon), Gort (River Bandon) with RPS, Industrial (Wexport IPC License, Little Island with ASU, Quarries (Torry Hill, Co. Limerick with RPS), Housing Developments (Tir na nOg, Kenmare with ASU), Sewage Treatment Plants (Killarney UDC-Pettit with ASU).

Dr. Liam O'Sullivan

Dr. L. O' Sullivan is a recognised authority in Ireland on otter ecology having undertaken an in-depth study of the species in the catchment of the Munster Blackwater as part of his doctoral thesis at University College Cork. He has represented Ireland at several international conferences on otters and their conservation and published several scientific papers on the subject. Dr. O'Sullivan contributes on a regular basis to the fauna sections of Environmental Impact Statements, including the following in recent years: Piggery Spread Lands Survey: Glannasack Piggery Extension in Upper Bride and Glashabuoy Catchments (with ASU), IPC Licences (Mallow and Carlow Sugar Factories) with ASU, Road By-Pass Surveys, Mallow, Fermoy, Glanmire and Buttevant By-Passes (with RPS), OPW Flood Alleviation Schemes (Carlow, Kilkenny, Dunmanway etc. with RPS).

Dr. Ted Hickey

Dr. Hickey is a lecturer in plant science at University where one of his specialisations is landscape ecology and visual impact. He is a partner in Arbus Landscape Consultants, carrying out work in the following areas: Softwork and Hardwork Landscape Design (Industrial and Private); landscape assessment particularly visual impact assessment, planning applications, soil and tree surveys and litigation work. Also, land surveys, digital photointerpretation and presentation graphics using CAD.

Eachtra Archaeological Projects

Eachtra Archaeological Projects is an archaeological services partnership established in 1996 in the south of Ireland. The range of professional services offered by the company includes:

- heritage projects
- planning permission applications with an archaeological dimension
- archaeological investigation prior to development
- archaeological section of EIA
- monitoring
- professional advice

- surveying
- underwater archaeology
- archaeological excavations
- lectures (e.g., REPS, local historical societies, etc.)
- heritage consultancy

The company has a staff of three partners and a core of six other archaeologists.

CADCO Ltd, Trafalgar House, Montenotte, Cork; Computer Imaging Consultants.

Mr John Bennett
Mr Shane 'O' Leary
Mr Bennett and Mr O' Leary are specialists in 3-D CAD and visualisation and Digital Terrain Modelling, using AutoCAD, Softdesk 3-D Studio software, etc.

Mr Darrell Nightingale, Glengarriff, Co. Cork; Electrical Consultant

Green Power Ltd, Consultants

Green Power is a wholly Irish owned Renewable Energy company based in Macroom. Green Power directors and staff have been involved in the design, construction and operation of renewable energy electricity generation projects in Ireland for up to 15 years. Collectively they own and operate the largest installation of private small hydroelectric power in Ireland. The renewable energy installations owned and operated by Green Power personnel and associated staff have produced up to 200 million kWh of electricity over the past fifteen years. This is by far the largest energy production from non-ESB renewable sources in the country.

Green Power and associates have a long track record of RE development in Ireland and has put together a team of locally based, experienced engineers, project managers, technicians and sub-contractors (civil, mechanical and electrical).

BONUS Energy A/S, NEG Micon A/S, Nordex Balcke-Dürr, Vestas Danish Wind Technology, the turbine manufacturers, have many years of experience in the supply and construction of wind technology. These reputable companies offer a comprehensive advisory service for the wind projects in which they are involved.

South Western Services Co-Operative Society, Developers

South Western Services (SWS) is a local company, based in West Cork, which was established in order to serve the diverse needs of farmers. With particular regard to the small size and low income potential of many West Cork farms, SWS has been to the fore in encouraging the development of alternative sources of income generation for farmers.

LANDSCAPE AND VISUAL EFFECTS (INCLUDING PHOTOMONTAGES)

RECEIVING ENVIRONMENT

Landscape

Mullaghmesha is situated in the northern sector of West Cork (see figure 12). The western and north western sectors of the West Cork region are essentially upland except for the lien basin and a lowland coastal strip running from Baltimore to Kinsale.

Running west and north west of a line from Rosscarbery to Dunmanway, the topography consists of hill and mountain regions with land below 65 m O.D. confined to narrow tracts in river valleys. A widespread characteristic of the topography is the contrast between the convex hillsides developed in association with rejuvenated drainage and their gentle summit slopes identified by Miller (1939) as the remnants of a 65 m - 130 m peneplane.

Upland hills within this region consist of the Maughanaclea Hills (453 m), Nowen Hill (537 m) and Mullaghmesha (494 m), the site of the proposed development. These upland hills have been described by Fahey (1969) as belonging to the Shehy - Cahermore upland, an axial upland mass extending approximately 20 km north - south embracing the Shehy Mountains, the Maughanaclea Hills and dissected upland lying to the south.

Landscape Character Zones

The overall character of Mullaghmesha and the landscape contained within a 5km radius of the centre of the proposed site can be divided into a number of character zones in terms of their visual and scenic importance. These zones shown as a colour category in figure 12 include the following:

- Upland Moor (yellow)
- Afforested Landscape (dark green)
- Valley Landscape (light green)
- Rolling Lowland (orange)

Upland Moor

This zone encompasses Mullaghmesha (496 m) and its associated hills Glanareagh (326 m) directly to the north west and Glandart (345 m) and Glanaclogha (356 m) directly to the south west and south respectively. It also includes the southern slopes of the Maughanaclea Hills to the north and to the east of Mullaghmesha the western flanks of Nowen Hill (509 m).

On the upper slopes of Mullaghmesha the terrain is gentle to moderately undulating. Mullaghmesha is steeply flanked on all sides except to the south where the landform is rolling and connected by a series of ridges to a number of smaller hills to the south west. The predominant landcover on Mullaghmesha is rough pasture and moorland with rocky outcrops. Two adjoining small lakes namely Lough Agower and Coomanore Lough are situated directly to the south west of Mullaghmesha peak with a smaller unnamed water body a short distance further south.

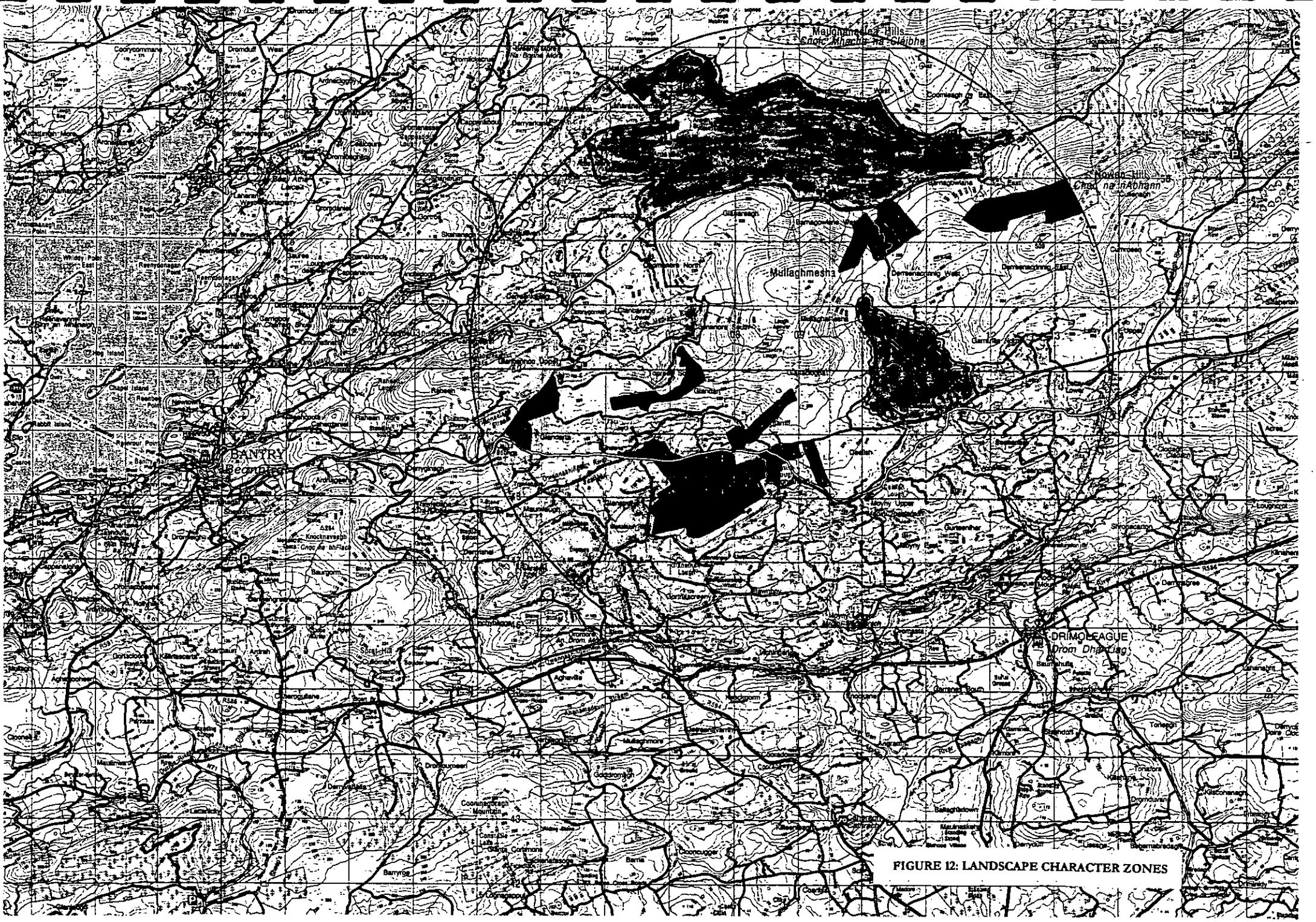

FIGURE 12: LANDSCAPE CHARACTER ZONES

Notable landscape elements on Mullaghmesha include tributaries of the Mealagh River on its western and north western flanks and the source water of the river Ilen on eastern and south eastern flanks. Access tracks to a number of well worked upland peat extraction sites are visible on the western, southern and south eastern flanks of Mullaghmesha. Mullaghmesha is criss-crossed by stock-proof fencing and on the south west slopes a series of dry stone walls and ruins testify to the historic and continuous influence of farming within the area.

Mullaghmesha is a medium scale exposed landscape and has no landscape value designation attached to it at local or national level. It is not remote nor could it be described as a wilderness.

Afforested Landscape

Within the area surveyed large blocks of semi-mature coniferous forestry plantation are visible on the southern slopes of Mullaghmesha at Baurgarriff and Deelish and on the south western upland spur at Kealanine (high point: Bull Rock, 305 m O.D.). Smaller isolated stands of semi-mature conifers are visible at Toureen south, on the north eastern flanks of Mullaghmesha at Barnagowlane West, along the western flanks of Nowen Hill and on the southern slopes of the Maughanaclea Hills.

The landcover provided by coniferous forestry is the dominant landscape element in the hilly terrain to the south and south west of Mullaghmesha. A series of third class roads and access tracks service the area.

In subjective terms this afforested landscape is bland, monochromatic, uniform (in terms of variety) and very ordinary. Due to the hilly landform and dominant landcover, the proposed development does not impinge visually on receptors (viewpoints and viewers) within this landscape zone.

Valley Landscape

a) Between the high ground of Mullaghmesha and Derreenacrinnig a deep gorge gives way to a narrow valley broadening out in a south eastern direction towards Castledonovan. From the high ground on both sides a series of steeply sloping incised stream valleys feed the source water of the river Ilen to the valley below. On the steep valley slopes the landcover comprises moorland vegetation with rocky outcrops, thickets of scrub and reclaimed pasture giving way further down the valley to extensive pasture on the lower flanks and undulating floor of the valley.

Landscape elements within the valley include the river Ilen, a number of farm buildings and associated coniferous shelter belts, hedgerows with trees, tree clumps, overhead telephone lines and power lines and a number of third class roads and upland access tracks.

The historically important and partially ruined 15th - 16th century castle after which the townland is named, is located just north of Castledonovan bridge at the broad mouth of the valley. The castle is listed as a structure of historic importance in the West Cork County Development Plan (1996). The castle built in 1560, is the ancient seat of the O'Donovan clan in the Barony of Carbery. It was destroyed and pillaged by Cromwellian forces in 1650 and has remained unoccupied since that time.

b) Between Mullaghmesha and the Maughanaclea hills to the north, a broad valley landscape approximately 1.5 km wide x 5.8 km long is bisected along its east-west axis by the Mealagh River. From the high ground to the north and south a number of minor tributaries feed this river.

The valley itself is bounded by a complex of three third class roads: two running east-west along the base of Mullaghmesha and Maughanaclea respectively, with the interconnecting Drumclogh - Ardsmore road separating the valley from rolling lowland to the west.

Valley topography ranges from flat terrain on the valley floor to gentle slopes on the northern and southern flanks. Towards the western edge of the valley, the landform is moderately undulating

and is steeply incised and lined with deciduous thickets and scrub along the banks of the Mealagh River.

Apart from the existing road system, valley landcover predominately consists of irregular field patterns consisting of small enclosures of improved pasture bordered by mixed hedgerows, fencing and dry stone walls. Most of the farm buildings are located close to the main road system and coniferous shelter belts are commonly associated with these buildings.

The valley is criss-crossed by numerous overhead telephone lines and power lines along the sides of the valley, field pasture gives way to broken terrain containing bracken (Pteridium aguilinum), gorse (Ulex europeaus), scrub and rough grasses with derelict land and moorland confined to higher ground.

In subjective terms, these valley landscapes (a and b) are simple, balanced, enclosed and small scale. While the derelict castle in the valley setting at Castledonovan could be described as unusual, the remaining valley landscape within the area surveyed, though pleasantly interesting, could not be described as rare or unique.

For most of the broad valley landscape (b) there is no visual impact in respect of the proposed development. Visual impact is confined to the western boundary of this zone where views of the development are largely intermittent.

Rolling Lowland

Within the area surveyed, rolling lowland is principally associated with the lower basins of the river Ilen to the south and south east of Mullaghmesha and the River Mealagh to the west and north west.

a) South and south eastern rolling lowland comprises part of an extensive river valley stretching from Castledonovan in the north to the coast beyond Skibbereen to the south. The northern sector of this landscape extends for a distance of 15 km from Sprat Hill in the west to hilly terrain north of Drinagh in the east. Within this landscape zone the area of survey mainly comprises rolling lowland with some hilly terrain located directly south and south west of Mullaghmesha.

The dominant landcover comprises an irregular field pattern of improved pasture bounded by hedgerows with trees, fencing and dry stone walls. Dotted throughout the landscape are numerous farm houses and private dwellings many with shelter belts and these are serviced by third class roads and access tracks bordered by scrub lined banks and mixed hedgerows. Occasional small blocks of coniferous plantation are visible.

The river Ilen, its tributaries and three small lakes are the dominant water bodies within this area. Along the Ilen the landform is frequently deeply incised and lined with scrub and isolated pockets of deciduous woodland, the largest being Moyny Wood situated north west of Drimoleague. Electricity powerlines and telephone lines criss-cross the area.

b) The western and north western rolling lowland is bounded to the north west by the high ground at Derryarkane and extends in a westerly direction from the already described broad valley landscape south of the Maughanaclea Hills and the Western flanks of Mullaghmesha towards a series of ridges and small hills overlooking the town of Bantry. It is bounded to the south by the Bantry - Castledonovan third class road. Apart from the River Mealagh and its tributaries, this area adjoins the important angling and scenic water bodies namely Drombrow Lough, Lough Bofinna and Cappnaboul Lough.

A 1.3 km long stand of semi-mature coniferous plantation runs adjacent and parallel along the eastern side of the minor road running from Lough Bofinna to Glanbannoo Upper and a smaller

coniferous block adjoins the Little Mealagh River at the base of the western slopes of Mullaghmesha. Apart from the topography which is less hilly, the landscape elements and land cover within this area are similar in type and extent to those already attributed to lowlands to the south and south east of Mullaghmesha.

In subjective terms the rolling lowland within the area surveyed could be described as open, of medium scale, varied (in terms of diversity) and dominated by pasture land. While the landscape is interesting and pleasant, its well managed appearance makes it ordinary in the lexicon of Irish landscapes.

Soil and Geology

A detailed soil survey of West Cork was undertaken by An Foras Taluntais from 1960 to 1962. Results were published in the West Cork Resource Survey (1963).

Soils of Mullaghmesha are classified as "Hill and Mountain" Complex C and consist of a complex of peats, podsols and skeletal soils with rocky outcrops. The peat is a climatic peat up to 1.5 m deep in places resulting from the slow decomposition and accumulation of plant remains under cold and wet climatic conditions associated with elevated regions. A contributory factor in its formation is the acid nature of the underlying geological material. The skeletal soil found on steep terrain consists of a partial cover of a thin black organic substrate. The podsol component is represented by the distinctive profile showing horizons of intensive leaching. The general fertility status of the soil complex on Mullaghmesha is low and it is only suitable for rough grazing, peat extraction and, to a very limited extent, afforestation. Its poor nutrient status is evident from the vegetation present mainly heather (Erica cinerea), purple moor-grass (Molinia caerulea), Sphagnum sp, poorer grasses and isolated thickets of scrub on lower slopes.

The underlying geology the proposed site is a sequence of uppermost Devonian Old Red Sandstone (ORS) rock types including Caher Mountain, Gun Point and Toe Head.

ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

Visual Survey and Methodology

A survey of the proposed site on Mullaghmesha and of the surrounding landscape was undertaken between 12th December 1997 and 2nd January 1998. Throughout the survey viewing conditions ranged from good to excellent.

A detailed and comprehensive visual survey was conducted by car and foot within a 5 km radius of the proposed site. Outside the 5 km zone, a selective visual survey incorporated the towns of Bantry and Drimoleague, third class approach roads to Mullaghmesha from Bantry, Dunmanway and Drimoleague, the N71 and R586 national and regional road network to the West and South of Mullaghmesha respectively and designated parking, picnic and viewing areas up to 12.2 km distant from the proposed site.

The Bantry - Glengariff and Parkana - Ballydehob sections of the N71 and the Dunmanway Coolkellure - Castledonovan - Bantry roads are listed as scenic routes in terms of views and prospects in the West Cork County Development Plan (1996).

Photography was carried out using an Olympus IS-3000 automatic single lens reflex camera with 35 - 180 mm variable zoom lens using 200 ASA Fuji Superia 35 mm colour print film. Photoviews of the site were taken from a number of external roadside locations representing

perspectives of the site where conflict potential could arise in terms of adverse visual impact. These locations are numbered 1 to 48 in figure 13. Plate 1 shows an aerial view of the site. Plates 2 to 7 represent selected photoviews from a number of different locations. A number of visual landmarks on Mullaghmesha were used to indicate the relative position of the proposed site. These included a test mast erected by Green Power Ltd on the western edge of the site, a television deflector mast situated near the eastern boundary and a telephone relay mast at the southern end of the site.

With reference to figure 13:

- Plate 2 was taken from viewpoint 2
- Plate 3 was taken from viewpoint 10
- Plate 4 was taken from viewpoint 41
- Plate 5 was taken from viewpoint 36
- Plate 6 was taken from viewpoint 44
- Plate 7 was taken from viewpoint 4

At each viewpoint, the observer's position including distance and bearing to the proposed site was recorded with bearings expressed in degrees relative to magnetic north using an Autohelm digital compass. The tables at the end of this section are a technical summary of this data. A desk study involved use of Ordnance Survey Map 85 Discovery Series (1:50,000) aerial photographs and a selection of published references detailed at the end of this section.

Existing Landscape Designations

In the West Cork County Development Plan (1996), Mullaghmesha and its immediate environs are not designated as a scenic area under the zoning provisions covering the Bantry and Skibbereen catchment areas. However the Dunmanway - Castledonovan - Bantry road is designated a scenic route. Mullaghmesha is not mentioned in *Areas of Scientific Interest in Ireland* (1981) or *the Inventory Of Outstanding Landscapes In Ireland* (1977).

The nearest listed area of visual/scenic importance to Mullaghmesha is Cousane Gap located 7.3 km northeast of Mullaghmesha. In the National Parks And Wildlife Service inventory of proposed national heritage areas (NHA's) and special areas of conservation (SAC's) (1997), there is no mention of Mullaghmesha or its immediate environs.

Site Visibility

Figure 14 is a map showing areas of site visibility within the survey area from roadside, residential and designated parking, viewing and picnic locations. The outer limits of the survey zone were dictated by accepted published national and international guidelines in relation to wind farm visual impact assessment (Stanton, 1996).

Site visibility was determined under conditions of "worst case scenario" [i.e. static viewing positions with good to excellent visibility].

In Figure 14 the degree of visual exposure with respect to the proposed site is shown as a colour category representing the following viewing conditions;

- Not Visible (Blue)
- Intermittent Views (Yellow)
- Fully Visible (Pink)

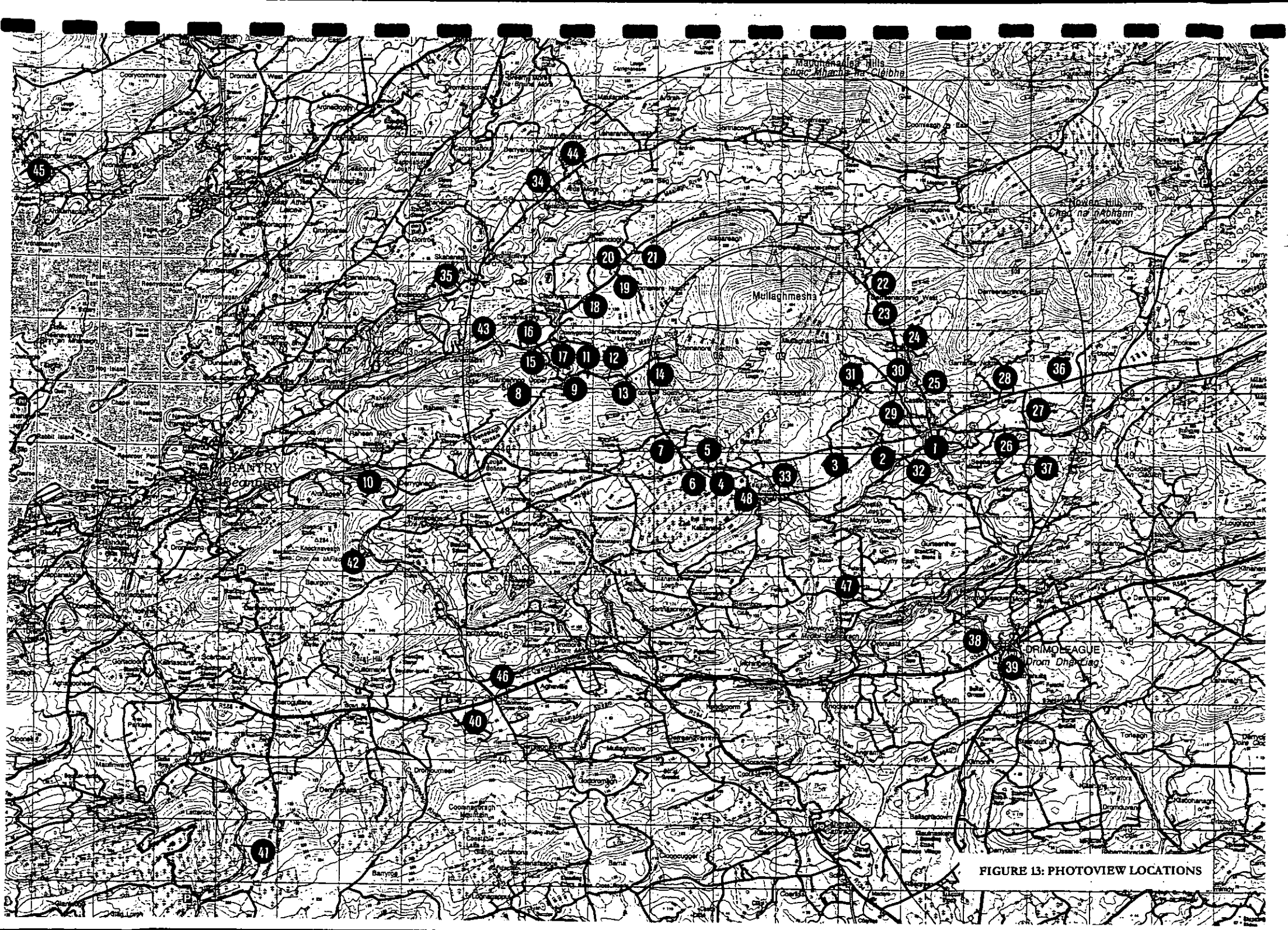

FIGURE 13: PHOTOVIEW LOCATIONS

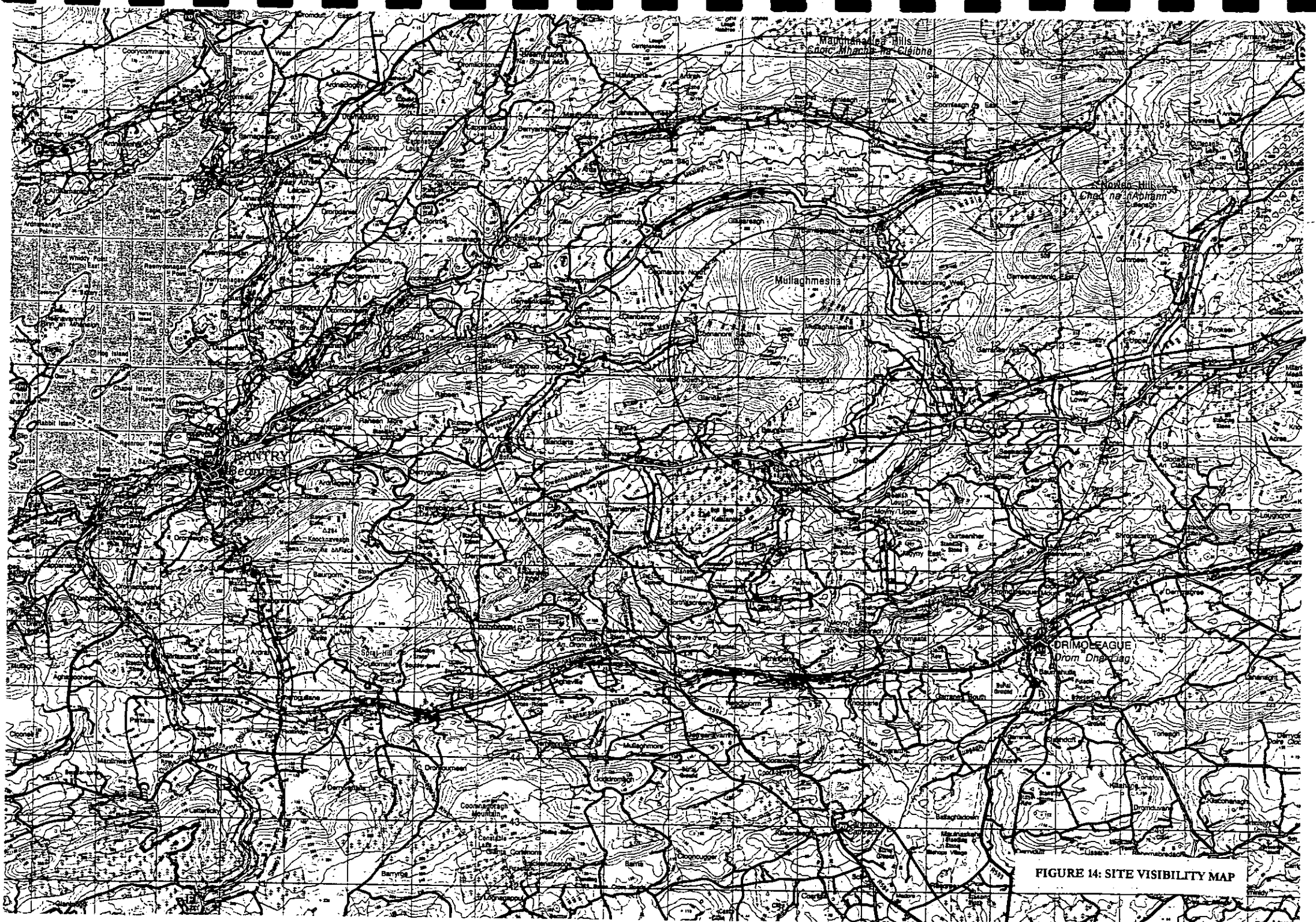

FIGURE 14: SITE VISIBILITY MAP

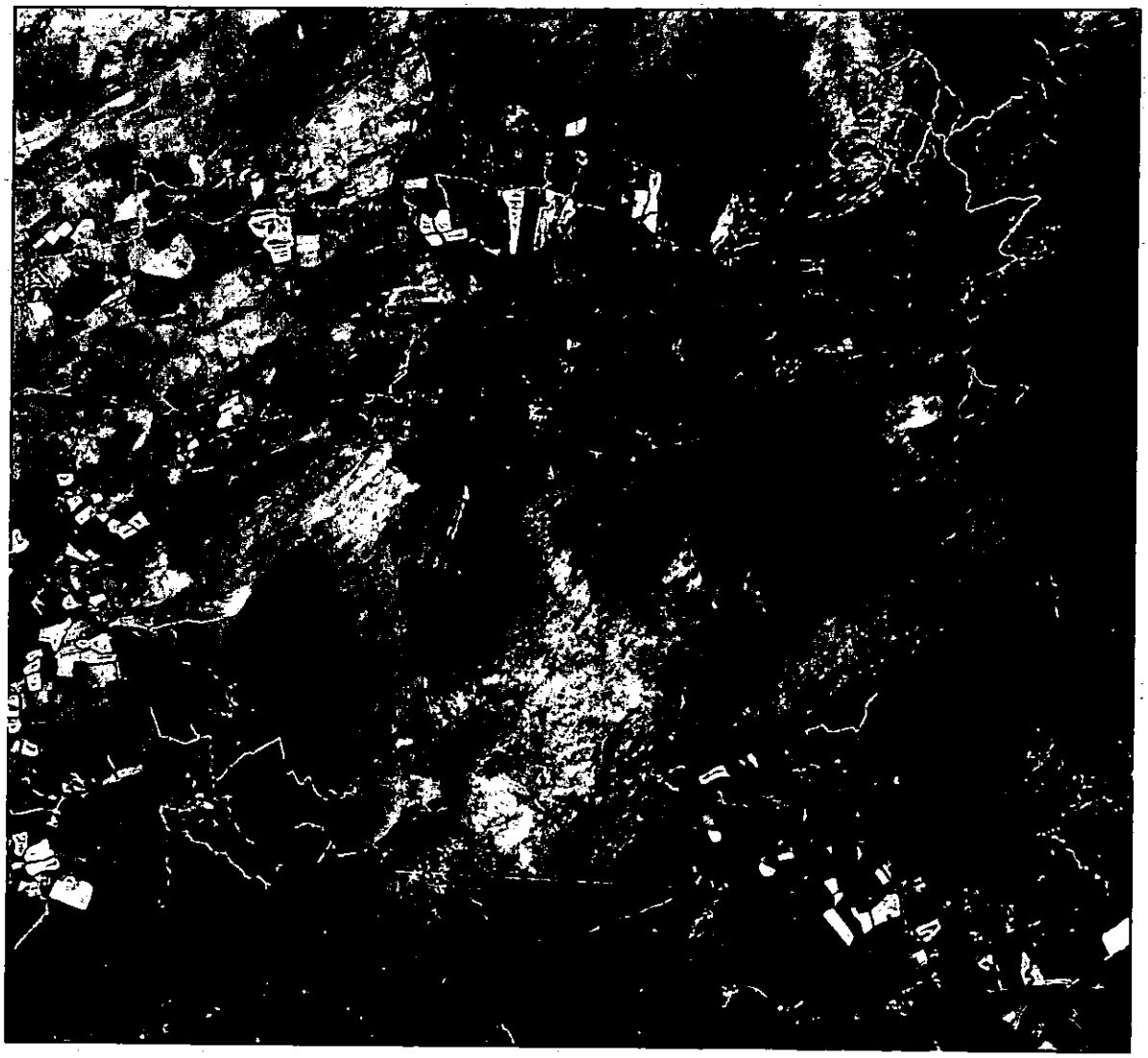

PLATE 1: AERIAL PHOTOGRAPH OF SITE

PLATE 2: VIEWPOINT 2

PLATE 3: VIEWPOINT 10

PLATE 4: VIEWPOINT 41

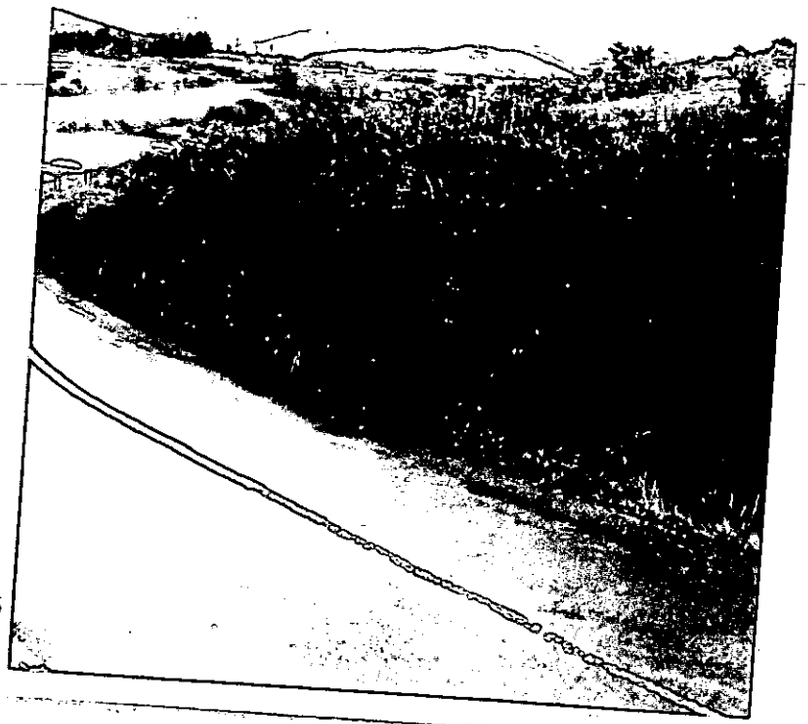

PLATE 5: VIEWPOINT 36

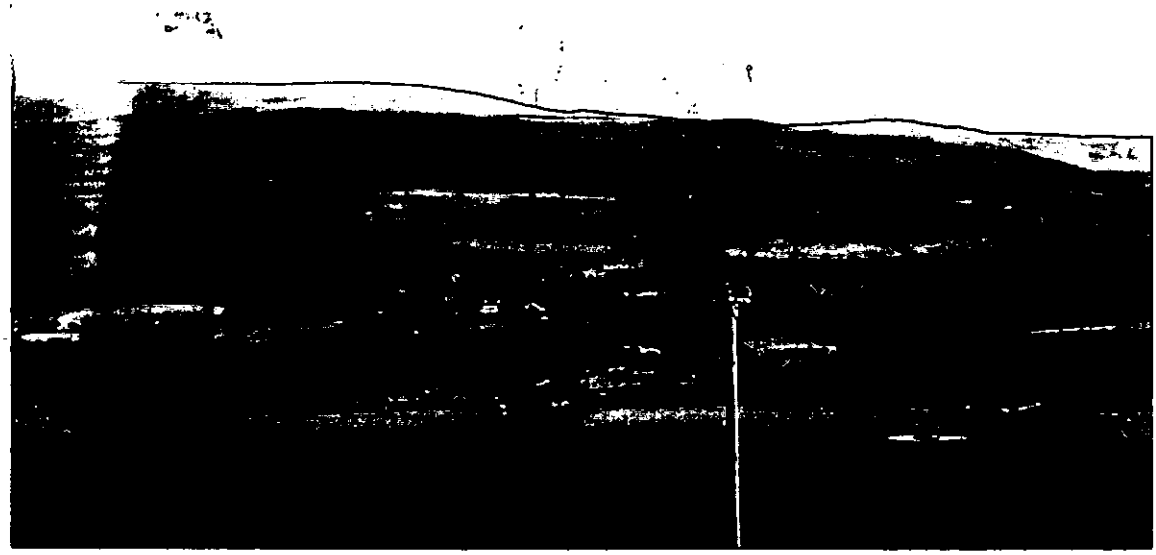

PLATE 6: VIEWPOINT 44

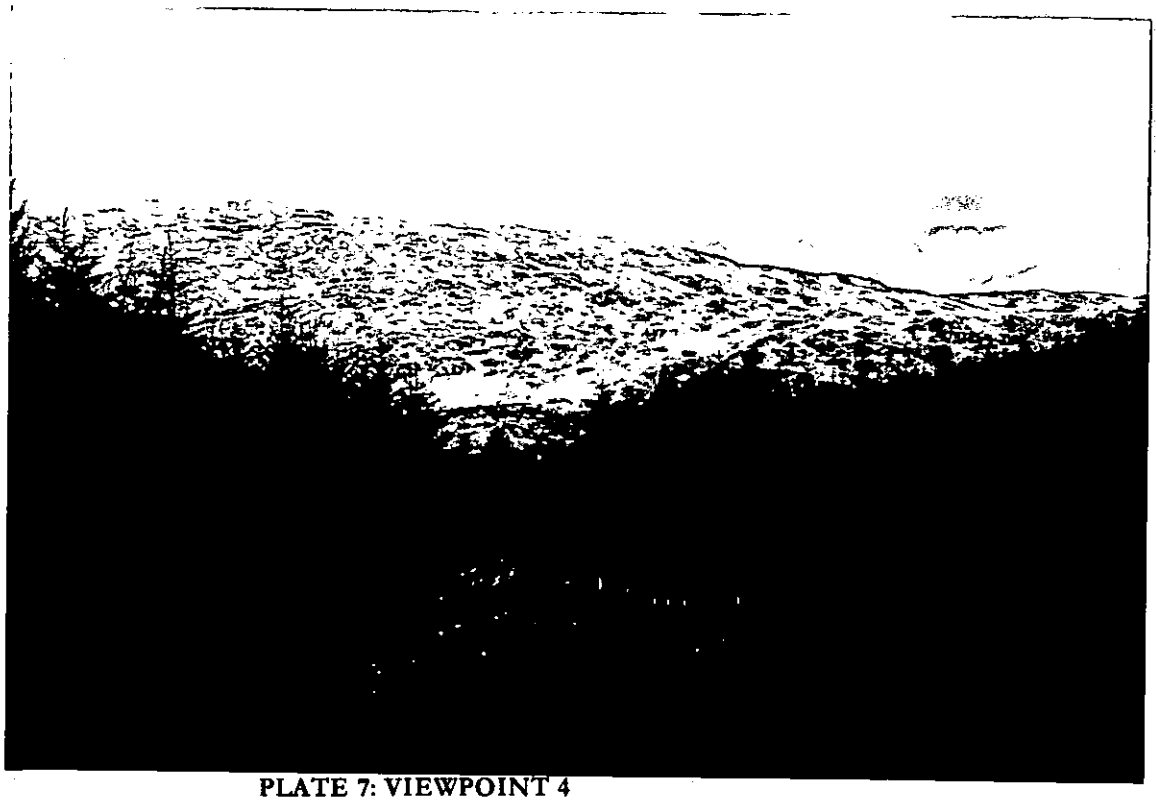

PLATE 7: VIEWPOINT 4

Photomontages

A 3-D contour map of the area was digitised, and converted to a surface model. 3-D drawings of the wind turbines were superimposed on the model at an exact scale.

Next, from the site visibility map, photographs of the proposed site were selected representing a range of important receptor types (i.e. viewpoints and viewers). Photographs were captured in bitmap format (BMP) using a flatbed colour scanner.

Knowing the viewpoint at which each photograph was taken, the focal distance of the camera lens, and the angle at which the photograph was taken, a position may be taken within the 3-D model at the photograph viewpoint, observing the same view as the photograph, but with the turbines included at scale. The photograph is then superimposed on the 3-D model, producing the photomontage.

Resulting images from a number of viewing perspectives within the survey area represent the projected visual impact of the wind farm location and design on viewers and on the landscape character and individual elements within the landscape. Images presented represent three broad classes of viewing perspective namely:

- Roads.
- Residential properties
- Landscape zones

In this report, photomontages representing the view from these perspectives together with their viewing locations (designated V with location number: see figure 13) are shown in plates for the following locations:

- Designated amenity areas on the N71 (Plate 8, V45)
- Dunmanway - Castledonovan - Bantry (designated scenic) road (Plate 9, V29)
- Residential properties near the site (Plate 10, V31, Plate 12, V16)
- Drimoleague (Plate 11, V38)
- Narrow valley with castle (Plate 9, V29)
- Rolling lowland (Plate 12, V43)

Visual Assessment Terminology

In terms of visual assessment, the following terminology is commonly employed to describe degrees of visual impact.

Imperceptible Impact: an impact capable of measurement but without noticeable consequences.

Slight Impact: an impact that causes changes in the visual character of the landscape which are not significant or profound. This applies where there is a low sensitivity to receptors and where a minor portion of the view is changed.

Moderate Impact: an impact that causes changes in the visual character of the landscape which may be substantial but are mitigated by being of short duration or of local significance. This applies where some changes occur in a restricted view, where the sensitivity of receptors is moderate for external users (such as visitors) or where the magnitude of the impact is low for residents in a landscape of high sensitivity.

Significant Impact: an impact which by its magnitude, duration of intensity alters an important aspect of the environment. This applies where the sensitivity of the landscape is high, where site changes substantially alter the overall scene and the impact magnitude is moderate or where the development alters the foreground or background at a particular location.

Designated Amenity Areas on the N71

In respect of the proposed wind farm the designated amenity areas on the N71 road (West Cork County Development Plan, 1996) are those adjoining viewpoints 41 and 45 on the Bantry - Glengarriff and Parkana - Ballydehob sections of this road (see figure 13).

Plate 8 (V45) represents a roadside photoview of the wind farm from an elevated viewing position, 12.2 km (viewing distance) from the site on the Bantry - Glengarriff road taken under excellent viewing conditions. From this perspective, the wind farm ascribes a broad visual arc appearing as an inferior element on the dominating landmass of Mullaghmesha. Turbine array appears as a single sculptural element within this exposed upland landscape. Due to the variable relief of the wind farm site, a slight degree of visual movement will result for traffic using the N71. The location of some turbines beneath the skyline will heighten visibility due to the contrast between turbines and the background moorland vegetation. However views of the wind farm from the N71 are distant and restricted to a small number of short segments of the road as is apparent from the site visibility map (figure 14).

Climatic records for the Bantry district supplied by the Irish Meteorological Service show that the wind farm will not be visible or visibility will be greatly reduced for much of the year. Records show that the annual number of hours of bright sunshine ranges from 1400 to 1500, annual rainfall is between 1400 and 1600 mm and the mean number of days with precipitation of 1 mm or more is 175.

For road users on the N71, the visual impact of the proposed development will be further moderated by the mode and speed of viewing, by the undulating topography and the diversity of landscape elements and landcover types present within the overall field of view. At this distance road users will be able to view the development at a quick glance and this should not pose a safety risk for traffic using the N71. Similar comments apply to the visual impact of the wind farm from roadside vantage points such as viewpoint 41 (figure 13) on the scenically important Parkana - Ballydehob road.

In summary an imperceptible to slight unavoidable and transient visual impact will result for road users at a restricted number of distant locations on the N71.

Dunmanway – Coolkellure – Castledonavan - Bantry Road

The site visibility map (figure 14) shows that the main degree of visual exposure to the wind farm in respect of this road is a 2.2 km relatively straight section of road on the approaches to Castledonovan from Dunmanway. The Dunmanway - Castledonovan - Bantry route is a designated scenic route (West Cork Development Plan, 1996) Plate 9 (b) represents a view of the development from viewpoint 29 close to this road.

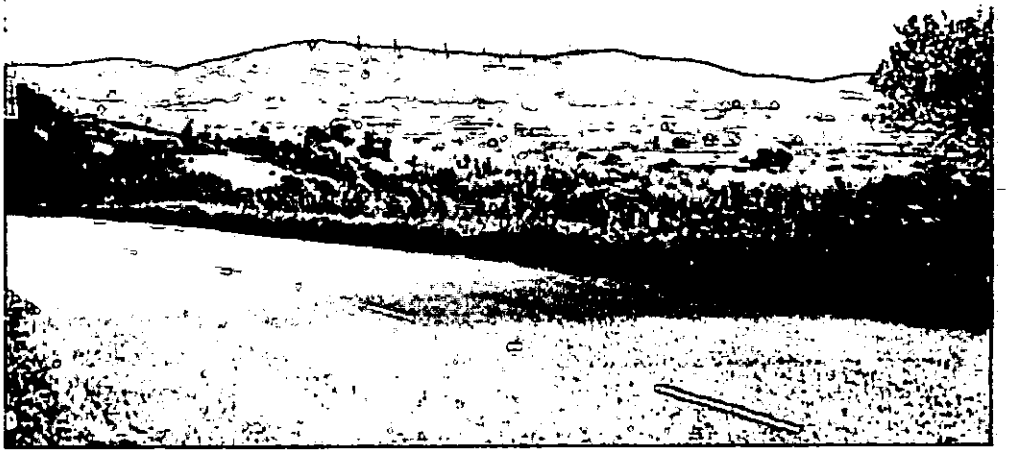

PLATE 8: VIEWPOINT 45

PLATE 9: VIEWPOINT 29

PLATE 9(B): VIEWPOINT 29

From this perspective a total of 7 turbines are clearly visible silhouetted in linear fashion on the skyline. The simple contrast of vertical and horizontal elements makes the wind farm clearly visible as an inferior element within the dominant upland landscape of Mullaghmesha. The turbine array produces an unambiguous, positive, tidy and honest image of unity, clarity and cohesion. Nassauer and Benner (1984) reported that perceived tidiness was a strong predictor of preference for landscape containing energy developments. As there are no distinct land use clues visible on Mullaghmesha, the wind farm appears as a single sculptural element in its own right. In terms of road safety, motorists on the aforementioned stretch of road will be able to view the development without taking their eyes off the road.

For most of the Dunmanway - Coolkellure - Castledonovan - Bantry road there are either no views or intermittent views of the development due to intervening landform and the presence of roadside vegetation particularly coniferous forestry plantations. Midground views are to be found on short stretches of the Bantry - Castledonovan road travelling in the direction of Lough Bofinna and in the vicinity of viewpoints 4, 5 and 6 (figure 13).

In summary a slight, unavoidable and transient visual impact will result for road users on restricted sections of the Dunmanway - Coolkellure - Castledonovan - Bantry road. Due to the intervening landmass of Nowen Hill to the west, the development will not be visible from the scenic Coolkellure area or from the nearby designated amenity area overlooking Cullenagh Lake.

Residential Properties near the Site

There are a total of 9 residential properties (mostly farm) located approximately 1 km from any turbine in the overall array. It is recommended that wind farms be located at least 1 km from the nearest residence to avoid excess visual impact to the occupants as well as to minimise the impact of other factors such as noise (Stanton, 1996). All residences within the 1 km zone of visual influence are located either on the lower flanks or at the base of Mullaghmesha. Many of these buildings are screened by adjoining coniferous belts, by tree copses of by blocks of mainly coniferous plantation. This is evident by examination of recently taken ordnance survey commissioned aerial photographs of the area (Plate 1). Foreground view in Plate 2 shows a nearby farmhouse with associated coniferous screening. Where views of the wind farm are unavoidable, the acute angle of viewing and the foreground topography will restrict visibility for residents to a small number of turbines at the edge of the array. Plate 10 represents a typical foreground view of the development from viewpoint 31 located at the edge of the 1 km zone of visual influence. In this view the turbines present a powerful dominant image of contrasting form, colour, shape, line and elevation.

At certain locations and with clear skies, the visual contrast will be further accentuated when turbines are viewed in silhouette against the setting sun. However it should be noted that a recent canvass of the aforementioned residents by the promoters of the wind farm has shown no opposition to the siting or layout of the proposed development. An extensive survey of local reaction to the development was carried out in December 1997 by Green Power and South Western Services. All households in an approximately 2 - 3 km radius were visited. In all, 59 homes were visited. The general response was very positive, and a keen interest in the technology was apparent. Information packs were distributed, and any queries relating to the development were satisfactorily dealt with.

PLATE 10: VIEWPOINT 31

PLATE 11: VIEWPOINT 35

In summary, a moderate to significant visual impact will result for some residents living within 1 km of the proposed development. However this impact will be restricted to views of a small number of turbines within a narrow arc of vision.

Drimoleague

Approximately 6km (viewing distance) south east of the proposed site on the Dunmanway - Parkana road (R586) lies the small village of Drimoleague (population *circa* 200). For residential properties facing north-south especially those located on high ground on the southern edge of village, the wind farm will be periodically clearly visible in midground view. Foreground views are dominated by a rolling landform, irregular field patterns (mainly pasture), and occasional tree copses.

Plate 11 represents a roadside view of the wind farm from Viewpoint 38 on the western edge of the village. In this photomontage the turbines are backlit to show maximum visibility against a grey sky. The wind farm is clearly visible in a broad arc of vision as a inferior element within the open, exposed and dominant landmass of Mullaghmesha and seven of the turbines are clearly silhouetted on the skyline. From this perspective, the turbine array does not appear as a single coherent feature. A variable visual relationship is evident between the turbines giving rise to a slight to moderate degree of visual movement. The white/grey colour and finish of the turbines will help blend them with the sky and irrespective of weather conditions or surrounding landcover will not produce an aesthetic clash in colour. The prevailing weather conditions in the area (already commented on) will substantially reduce the overall visual impact for much of the year.

In summary, a slight visual impact will result for some residents of Drimoleague under conditions of good to excellent visibility.

Narrow Valley with Castle

The contrast between the proposed wind farm and a 16th century structure of designated historic importance is an enclosed valley setting (see figure 12, Landscape Character Zones) will compromise, to some degree, the perceived historical and monumental value of this building within the surrounding landscape. In environmental impact terms this perceived impact is described as a contrast of association, a very intangible type of contrast between what we experience and what we expect (Brady, Skehan and Walsh, 1991). A number of different turbine arrays were carefully examined in order to minimise the visual impact and associated contrast of association generated by the development.

What is regarded as an optimum turbine array is shown in Plate 9(b) and represents a photoview from viewpoint 29 beside the castle. Turbines are clearly visible in a broad arc of vision as a coherent but inferior element against the dominant landmass of Mullaghmesha. On the skyline, turbine visibility, contrast and spacing are consistent and there is no sense of visual movement or confusion. Turbine colour and finish will help blend these structures in the sky background.

Plate 9 shows an earlier rejected proposal for an alternative turbine array in respect of the same viewpoint. The two hillside turbines nearest the viewpoint disrupt the overall visual coherence of this non-linear array, increase turbine contrast and movement and create an overall sense of visual ambiguity.

In overall terms a slight to moderate visual impact will result for valley residents and visitors alike in respect of the proposed development. A contrast of association will be experienced (especially by visitors) by the visual juxtaposition of old (16th century castle) and new (wind farm). The proposed turbine layout is the best compromise between the demand for wind farm technical and economic efficiency and preservation of the local scenic and cultural heritage.

Rolling Lowland

In the description of landscape character zones surveyed (figure 12) rolling lowland is located within a 5 km radius of the proposed site to the west, south and south east of Mullaghmesha.

Within these areas, the type of landform, landcover and range of landscape elements is broadly similar. Plate 12, V16 represents a typical view from rolling landscape 3.5 km (viewing distance) west of the site. Foreground views are dominated by rolling landform, tree and scrub-bounded irregular shaped fields (mainly pasture), residential properties and overhead telephone lines and power lines. Turbines appear clearly visible within a narrow arc of vision in full of part-silhouette on the skyline as a inferior but coherent element in the dominant Mullaghmesha landmass. Except for the lower towers of three turbines situated on the western edge of the wind farm, turbine contrast is consistent, spacing is fairly regular and there is little visual movement evident. Due to the variable relief of the wind farm site, a very slight degree of visual confusion will be generated by the turbine array.

In visual terms, the wind farm array does not conflict with the shape of the ridgeline vegetation or lower diagonal slope of the adjoining coniferous plantation at Toureen South. However for views closer than 2 km to the wind farm, a degree of visual conflict will result in respect of a small number of isolated coniferous stands located at the foot of the midwestern flanks of Mullaghmesha and their visual relationship to skyline turbines. For rolling lowland to the west and south east of Mullaghmesha, clear view conditions with a rising (west) or setting sun (south east) will heighten the visual contrast of turbines on the skyline. The turbine colour and finish will help blend in these structures in the background of sky. For viewing distances greater than 2 km, the prevailing weather conditions in the area (already commented on) will further reduce the overall visual impact for much of the year.

In summary, a slight visual impact will result for receptors in rolling lowlands within a 5 km radius of the proposed site. Views from a southerly and south westerly perspective will be restricted or obscured by intervening hilly topography and extensive coniferous plantations. At distances of less than 2 km from the development the visual impact will range from slight to moderate.

AVOIDANCE, REMEDIAL OR REDUCTIVE MEASURES

During the planning process a number of design factors were carefully considered in order to minimise the overall visual impact of the proposed development at Mullaghmesha. These are discussed under the headings **Landscape**, **Turbines** and **Ancillary Development**.

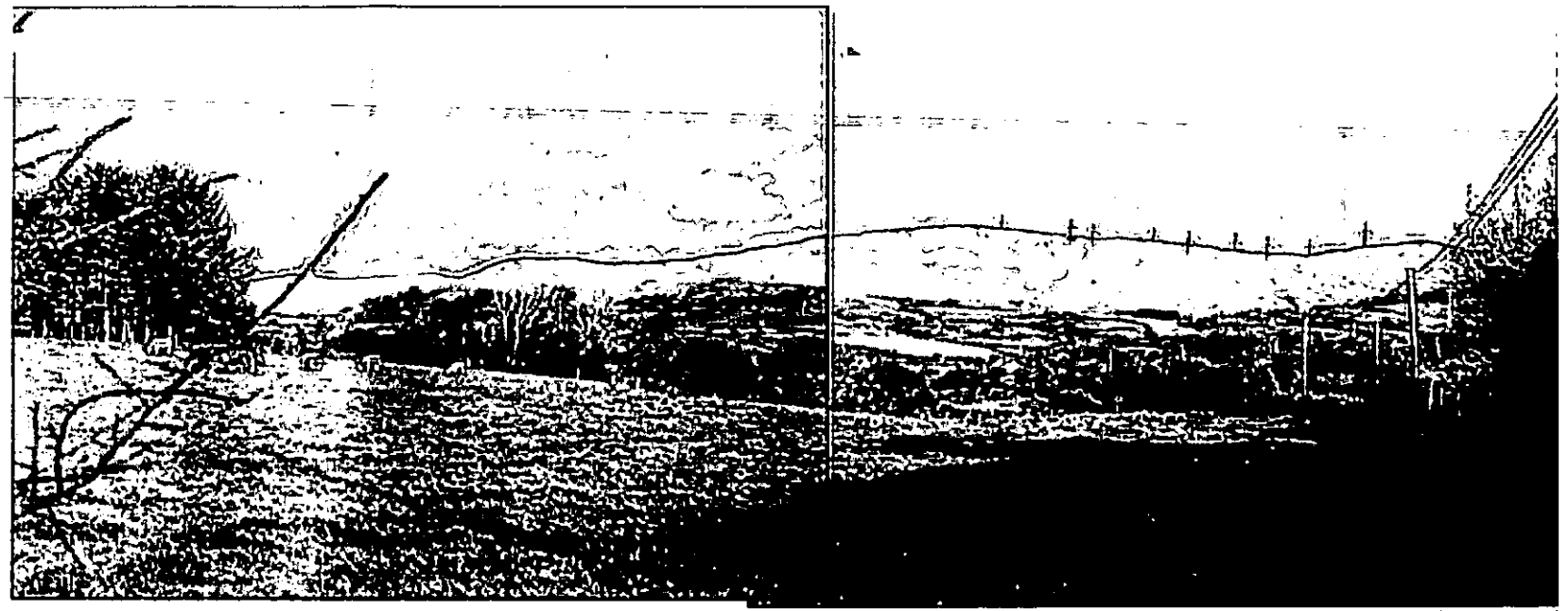

PLATE 12: VIEWPOINT 16

Landscape

Windfarm design was influenced by existing landform, landcover and landscape elements on Mullaghmesha. The Mullaghmesha landscape is essentially an exposed upland moor and is the dominant visual characteristic in the area. However it is not remote nor could it be described as a wilderness and has no landscape value designation attached to it at local or national level. The landscape has been much affected by human influence and this is evident by the presence of coniferous plantations, peat extraction sties, fenced-in rough grazing areas, telecommunication masts and a number of access tracks. The introduction of a further functioning element will not unduly detract from the overall value of the existing landscape.

In terms of landform, the overall visibility of the turbine array was significantly reduced by locating the wind farm on relatively flat topography situated just below the summit of Mullaghmesha (see figure 4: Site Layout).

Turbines

Design factors considered included turbine make (design and size), colour and finish, number of turbines, turbine array and operating characteristics. The proposed wind farm will consist of a total of (16 - 20) x (40 - 45) m (hub height), 3-bladed, horizontal axis type, solid tower turbines arranged in an ordered semi-formal array. By international standards turbines are small to medium sized and the size of the wind farm would be considered as small (25 - 50 turbines is regarded as being of moderate size). For most receptors, turbines will be seen in full or part silhouette on the skyline and the colour and matt finish will help reduce overall reflectivity allowing turbines to blend with the sky background.

The 3-bladed turbines which will spin in the one direction are visually balanced while the solid towers are simple in shape and sculptural in form.

Within the overall array, there will be a high degree of intervisibility between turbines giving a visual image that will be clean, rational and simple. For most receptors the vertical visual profile of the turbines and the extent of turbine visibility will be compatible with the overall medium scale character of the Mullaghmesha landscape. The absence of visual scale indicators on Mullaghmesha will also mean that the turbines will appear relatively small sized in relation to this exposed landscape.

Ancillary Development

To minimise any adverse visual impact, good design practice was followed in respect of ancillary development associated with the proposed wind farm. Ancillary development included the following:

- Compound
- Grid connection
- Service roads

Compound

The compound contains a control building, a transformer and ESB primary gear (figure 7). An underground cable will carry wind farm generated electricity to the compound which is located at the southern end of the site (figure 4). The compound location, its layout, vertical visual profile and building and perimeter finish were carefully considered to minimise the visual impact of this facility on the surrounding landscape.

Grid Connection

The electricity supply (38 kV) from the compound will be carried on overhead wooden poles to connect to the nearby ESB distribution system. In as far as possible, poles will follow field boundaries, roads and other linear landscape features and will not cross open landscape. The length of new overhead 38 kV line required to connect to the existing ESB line from Dunmanway to Bantry is 1.1 km, and its possible route is shown in figure 3.

Service Roads

A minor road network will service the turbines on site. These follow contours where possible to minimise visibility, and reduce potential for erosion (see figure 4)

CONCLUSIONS ON VISUAL IMPACT

In this study, the siting and design of a wind farm was carefully considered in respect of the scale and character of Mullaghmesha and the surrounding landscape. A detailed assessment was made on the perception of the development in terms of the overall character and individual elements comprising the landscape within a 5 km radius of the proposed site and at numerous locations up to 12.2 km from the site.

Particular attention was paid to the visual impact of the development in respect of the existing landform, skyline and land use. Turbine design elements considered included type, size, colour, spacing, number, array and operating characteristics. Good design practice was also followed to minimise the visual impact of ancillary development such as buildings, on-site service roads and power connections to the national grid.

WIND FARMS ARE NORMALLY LOCATED ON EXPOSED LANDSCAPES DUE TO THEIR TECHNICAL REQUIREMENTS FOR WIND SPEED AND WIND CONSISTENCY. WHILE THE VISUAL IMPACT OF WIND FARMS CANNOT BE ELIMINATED, GOOD DESIGN PRACTICE WILL AMELIORATE ANY ADVERSE VISUAL IMPACT TO AN ACCEPTABLE DEGREE FOR MOST RECEPTORS LIVING WITHIN THE VISUAL ENVELOPE OF THE MULLAGHMESHA DEVELOPMENT. HOWEVER FOR RESIDENTS LIVING WITHIN 1 KM FROM ANY TURBINE IN THE OVERALL ARRAY, A MODERATE TO SIGNIFICANT VISUAL IMPACT WILL RESULT.

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TABLE 1: VISUAL IMPACT ASSESSMENT: PHOTO VIEWS OF SITE FROM EXTERNAL LOCATIONS

Viewpoint	Photo. No.	Lens	Bearing
1	1, 32 33, 37	1, 32, 37 = N 33 = X2.7	1 = 298° 32, 33 = 290° 37 = 285°
2	2	N	315°
3	3.44	3 = N 44 = X0.45	3 = 330° 44 = 315°
4	4	N	11° 38°
5	5, 6	5 = N 6 = X0.45	29°
6	7	N	31°
7	8	N	48°
8	9, 10	N	88° 97°
9	11	N	86°
10	12	N	91°
11	13	N	90°
12	14	N	89°
13	15	N	105°
14	16	N	92°
15	17, 18	N	85°
16	19	N	92°
17	20	N	111°
18	21	N	138°
19	22, 23, 24	22 = N 23, 24 = X2.7	139°
20	25	N	146°
21	26	N	128°
22	27, 28	27 = N 28 = X0.45	242°
23	29	N	257°
24	30	N	275°
25	31	N	290°
26	34	N	280°
27	35	N	275°
28	36	N	281°
29	38, 39	38 = N 39 = X0.45	283°
30	40, 41	40 = N 41 = X0.45	282°
31	42,43	42 = N 43 = X0.45	292°
32	45	N	307°
33	46	N	340°
34	47	N	142°
35	48	N	115°
36	49, 50	49 = N 50 = X2.7	267°

Table 1 contd.

Viewpoint	Photo. No.	Lens	Bearing
37	51	N	307°
38	52, 53, 54	52 = N 53 = X2.7 54 = X0.45	324°
39	55	N	325°
40	56	N	47°
41	57, 58, 59	57, 58 = N 59 = X2.7	54°
42	60	N	57°
43	61, 62	N	84°
44	63, 64	N	141°
45	65, 66, 67, 68, 69	65,66,69 = N 67 = X2.7 68 = X0.45	113°
46	70	N	40°
47	71	N	351°
48	72	N	341°

NOTE: 1. VIEWPOINT:: **FOR VIEWPOINT LOCATION SEE FIGURE 7**

2. LENS: **N = NORMAL VIEWING (100%)**

X0.45 = 35MM PANORAMIC, REDUCED MAGNIFICATION (45%)

X2.7 = 180MM ZOOM, INCREASED MAGNIFICATION (270%)

3. BEARING: **PHOTOVIEW LOCATION EXPRESSED IN DEGREES (MAGNETIC NORTH) RELATIVE TO PROPOSED SITE**

NOISE

RELEVANT CHARACTERISTICS OF THE PROPOSAL

The proposed development consists of sixteen to twenty wind turbines, each 40 - 45 metres at hub height, located as shown in figure 15. Of the turbine layouts examined, this layout was considered the worst case for noise. The positions of the nearest residences are also shown.

Noise evaluation

In this section of the Environmental Impact Assessment, the predicted noise level from the proposed development is compared with the existing noise level at the nearest residences. The existing noise level is established by a baseline noise measurement.

THE RECEIVING ENVIRONMENT

Baseline Noise Measurement

To establish the existing noise levels in the vicinity of the residences nearest to the proposed wind turbines, continuous noise measurements were taken for a period of almost two days, from 16:00 h on Tuesday 9 December 1997 to 14.00 h on Thursday 11 December, at a point 15 m to the north of the residence of Mr Denis O'Leary, Glanaclogha, Drimoleague (see figure 15). Following some short period noise measurements at several locations, the noise level at this location was considered representative of the noise levels at the other residences nearest to the location of the proposed wind turbines.

Noise Measurement Equipment

The short period measurements were taken using a hand held Cirrus integrating sound level meter, model type CR702, Serial No. 016487. The twenty four hour measurement was taken with a Larson Davis integrating sound level meter, model type 820 (Serial No. 820 A0666). Sound level calibrator type 5.11D. Outdoor Type 1 microphone. The meters were set to sample A-weighted levels 32 times per second. The fast response was used.

Instrument Positions

All measurements were taken at a microphone height of 1.5 m. and at a distance of over 3 m from any reflecting surface.

Weather Conditions

The measurement location is in an upland exposed area. Varying measurement conditions prevailed during the two day measurement period with estimated wind speeds significantly greater than 10 ms^{-1} for part of the first night period as can be seen from figure 16, which shows the graph of the continuous noise measurement.

Results of Measurements

The short duration measurements taken on 9th December 1997 gave 15 minute values of the L_{Aeq}, the equivalent continuous A-weighted sound pressure level of between 35 and 40 dBA at various points in the vicinity of the nearest residences. A graph of the continuous L_{Aeq} measurement taken near the residence of Mr D. O'Leary is shown in figure 16. It can be seen that there is little difference between the day and night noise levels. From these measurements, the following day-time and night-time L_{Aeq} values for periods without high winds were determined:

Day-time L_{Aeq} (08.00 - 22.00 h) = 42 dBA

Night-time L_{Aeq} (22.00 - 08.00 h) = 42 dBA

As can be seen from figure 16, there are occasions when the noise levels are very low. The night-time background noise level (L_{A90}) was measured as 33 dBA.

Noise from Wind Turbines

Noise is generated by the turbine blades passing through the air as the hub rotates and by the gearbox and generator in the nacelle. Noise from the blades is minimised by careful attention to the design and manufacture of the blades. The noise from the gearbox and generator is contained within the nacelle by sound insulation and isolation materials.

Next to the turbine it is usually possible to hear a swishing sound as the blades rotate; the whirr of the gearbox and the generator may also be audible. However, as distance from the turbine increases, these effects are reduced.

The predicted noise levels from the proposed turbines is normally compared with the background noise which exists in the area at present.

POTENTIAL IMPACTS OF THE DEVELOPMENT

Noise Levels from the Proposed Development

The proposed development consists of sixteen to twenty, *c.* 40 - 45 m high wind turbines, located as shown on Figure 15 (this layout being the worst case for noise).

The maximum sound power level emitted from each turbine is approximately 99 dBA. Figure 17 gives typical noise emission values at various distances from the turbine base. The residences that would be most affected by the turbine noise are marked on figure 15. The maximum potential noise impact would occur when the wind is blowing from the turbines towards these residences. The predicted maximum noise level at each of these residences is shown on Table 2 overleaf. The calculation of these noise levels is based on conservative assumptions such as ignoring the shielding effects of intervening ridges, rock outcrops, etc; it is likely that the noise impact would be even lower than that estimated.

TABLE 2: EXISTING AND PREDICTED NOISE LEVELS AT NEAREST RESIDENCES

Residence	Turbine noise level (L_{Aeq})	Existing night level (L_{Aeq})	Predicted L_{Aeq} level	Predicted L_{A90} level
D. O'Leary	32	42	42	36
T.J. O'Leary	38	42	43	39
H.& C. Wehrli	32	42	42	36

(L_{Aeq} = sound power level; L_{A90} = noise exceeded for 90% of the time)

It can be seen that the noise from the proposed development is very low and is unlikely to be audible at the nearest residences except perhaps during very quiet periods.

Recommended noise levels

Preliminary recommendations from the wind turbine noise working group established by the UK Department of Trade and Industry are that turbine noise levels should be kept within 5 dBA of the average existing evening or night-time background noise level. This is in line with standard practice for assessment of most sources of noise apart from transportation and some mineral extraction and construction sites when higher levels are usually permitted. In very quiet areas such as the proposed location a fixed low level such as 40 dBA may be specified.

LIKELY IMPACTS OF THE DEVELOPMENT, AND CONCLUSIONS ON NOISE IMPACT

Summary of Noise Impact

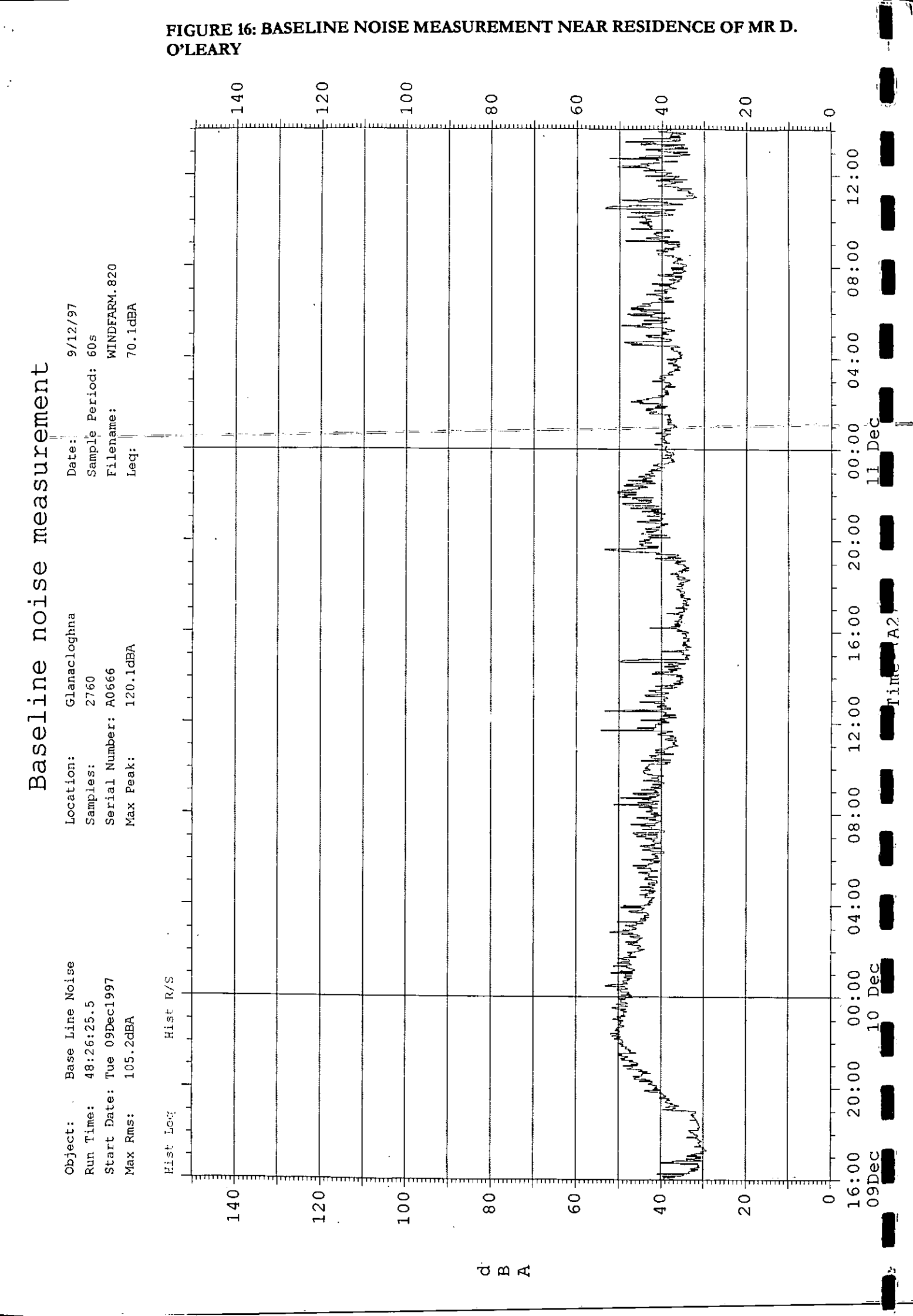
The maximum predicted noise levels with all of the proposed wind turbines in operation are shown for each of the nearest residences in Table 2. It can be seen that these levels are almost identical to the measured existing night-time noise levels (L_{Aeq}) also shown on that table. Also the predicted background noise level (L_{A90}) is less than 40 dBA at all these residences.

Noise level contours for the area in the vicinity of the proposed development with all the wind turbines in operation are shown in figure 15. It can be seen that the noise levels in the vicinity of any residences are very low and that the turbine noise would not normally be audible.

It should also be noted that the noise levels even at the bases of the turbines are substantially below those at which any hearing damage could occur for those working at turf cutting, etc., for extended periods. The maximum noise levels experienced would be approximately 61 dB; at about 100 m from the bases of the turbines, the noise level would be about 51 dBA.

FIGURE 15: LOCATION OF WIND TURBINES AND NEAREST RESIDENCES, WITH PREDICTED NOISE LEVEL CONTOURS

FIGURE 16: BASELINE NOISE MEASUREMENT NEAR RESIDENCE OF MR D. O'LEARY



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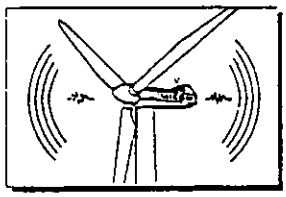
NOISE EMISSION



NOISE EMISSION

Wind Speed	LWA ref	Frequency (Hz)					
m/s	dB(A)	125	250	500	1000	2000	4000
8	98.7	86.4	92.9	94.0	91.5	88.0	96.2

The measurements are according to the Danish Ministry of the Environments Announcement. No. 304. date: 14. may 1991

Accuracy to ± 2 (dB) Micon. Rap. P5.005.95 [95-03-17]

Distance m	Noise dB(A)
0	61.0
25	58.7
50	55.1
75	52.2
100	49.8
125	47.9
150	46.2
175	44.8
200	43.6
225	42.4
250	41.4
275	40.5
300	39.6
325	38.8
350	38.0
375	37.3
400	36.6
425	36.0
450	35.4
475	34.8
500	34.2
525	33.7
550	33.1
575	32.6
600	32.1
625	31.6
650	31.2
675	30.7
700	30.3
725	29.9
750	29.4
775	29.0
800	28.6
825	28.2
850	27.9
875	27.5
900	27.1

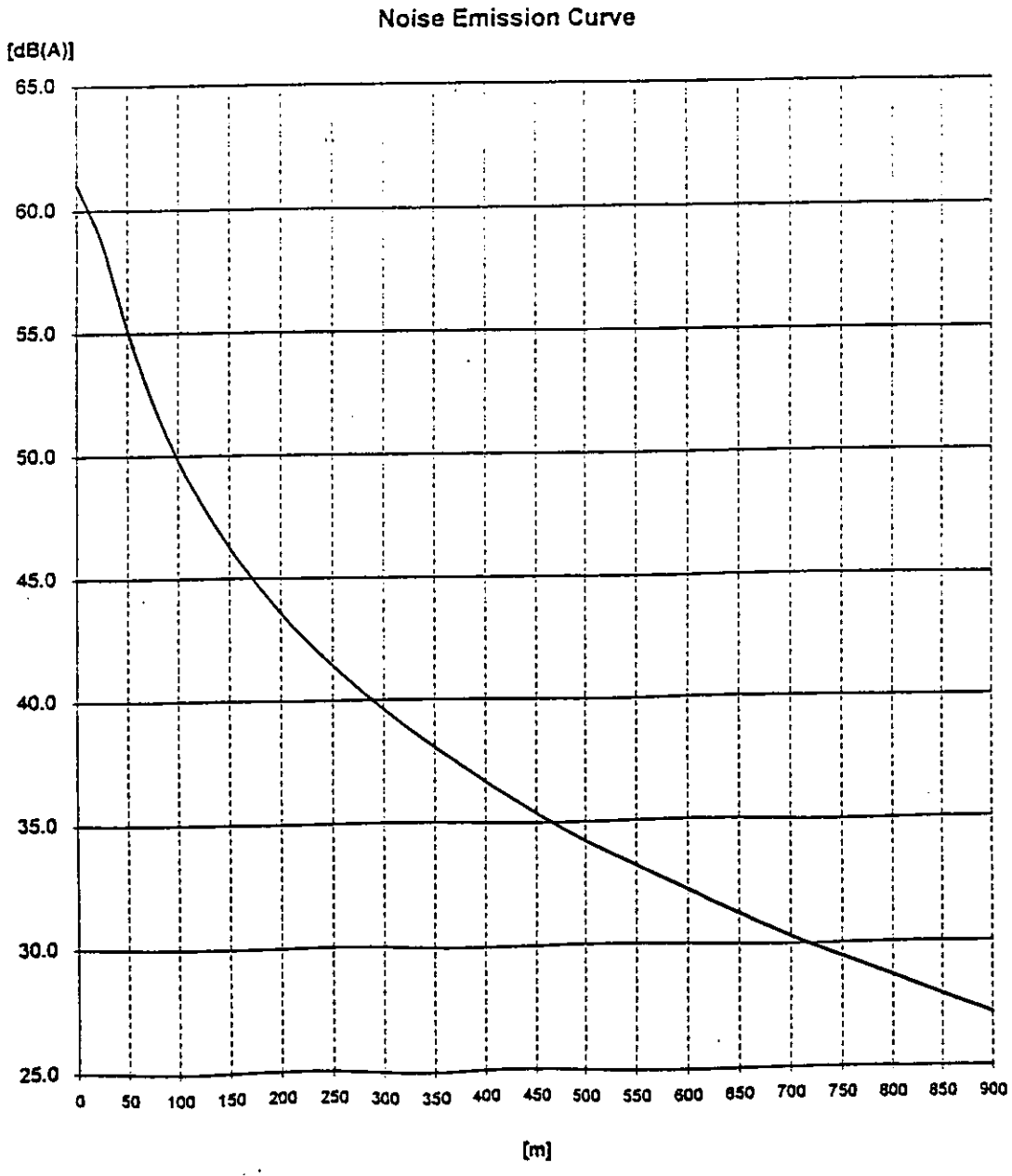


FIGURE 17: TYPICAL NOISE EMISSION VALUES FOR A WIND TURBINE

ELECTRO-MAGNETIC EFFECTS

RELEVANT CHARACTERISTICS OF THE PROPOSAL

It is established that rotating blades of a wind turbine may cause interference to electromagnetically propagated signals. While such interference can impact all forms of electromagnetic communications such as satellite communications, RADAR, cellular radio communications, aircraft instrument landing systems, terrestrial microwave links and television broadcasts, the remote location of the proposed development at Mullaghmesha eliminates from consideration all but the last two.

POTENTIAL IMPACTS OF THE DEVELOPMENT

The interference, which is caused 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.

The signal scattering as a result of the obstruction presented by the blades, an effect which mimics the presence of a lower power source operating from the location of the wind turbine.

The signal obstruction as it passes through the area swept by the rotating blade, and as a consequence undesired modulation.

Large wind turbines that act as sources of re-radiation, produce delayed 'ghost' signals which 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 will 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 antennas 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 antennas will not provide discrimination against the strong reflected signals.

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.

LIKELY IMPACTS OF THE DEVELOPMENT

Electro Magnetic 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.

Terrestrial TV Interference

As already identified, the two primary modes of interference to TV reception produced by horizontal axis wind turbines are

- Forward scatter
- Backward scatter

Forward scatter is produced when the wind turbine obstructs the path of the signal before it reaches the receiving antenna, producing an amplitude modulation component in combination with a scattered component. The distortion that results on the TV screen is primarily that due to intensity modulation. This however can be compensated in most TV sets by standard AGC circuits. Another form of distortion can be the presence of a ghost image, but this is usually insignificant due to minimal delay between the direct and the scattered signal.

Backward scatter is produced when the receiving antenna is between the wind turbine and the transmit antenna. In this configuration the receiving antenna receives a signal directly from the transmitter, but also receives a backward scattered signal that will have some time delay. This interference mechanism can be briefly summarised as follows; as the scattered signal travels a greater distance than the primary signal which goes by the more direct route, it will arrive at the receiver after a delay period. In the case of a scattered signal which travels an extra 1 km, the delay is 3.3 micro seconds which is sufficient to produce a second image which is offset from the primary image by 1/15 of the screen. While such an image may be tolerable in some instances, and more so in areas which suffer the effect of multi-path due to the presence of large reflectors such as those presented by mountains, it has been recognised that the effect of pulsating 'ghosts' of a television picture causes more discomfort than a constant 'ghost' of the same mean magnitude.

For either case of forward or backward scatter however, it has been found that it is worse in all case at the higher frequencies and so therefore presents more of a problem at UHF than at VHF.

The main RTE transmitter in the south west of Ireland is located in Mullaghanish, 15 km north west of Macroom. This transmitter with a mast reaching 850 m above sea level broadcasts RTE 1 (channel D) and RTE 2 (channel G) at VHF frequencies. The signal from this transmitter feeds a large number of transposer stations, including the one at Seskin that services the Bantry and Glengarriff areas.

While some interference to RTE TV reception can be expected in the locality of the wind turbine array, a number of factors mitigate against this being an issue which will have any significant negative impact on the quality of RTE TV reception in the area of the proposed development:.

- Interference limited to the immediate vicinity of the wind turbine array.

- Sparsely populated mountainous area.
- TV reception in this area is at VHF frequencies that are less susceptible to interference.

To secure an adequate quality TV signal it is necessary to have a margin of at least 30 dB between the signal and unwanted interference. Given the circumstances relating to the location of the proposed wind turbine array, this objective should be realised when receiving signals from Mullaghanish in all but an area of a few km from the proposed development

Point to Multipoint Microwave TV Interference

A Multipoint Microwave Distribution System (MMDS) is a system in operation in Ireland that provides TV/video distribution by utilising 200 MHz of bandwidth at 2.5 GHz.

Irish Communications have been licensed by the Department of Communications to operate MMDS in the cell encompassing Mullaghmesha. This system, which is point to multipoint, transmits from a single location and is received at multiple sites. Point to multipoint operation at microwave frequencies requires line-of-sight from the transmitter to all receivers, a situation that is not feasible in a location with hilly terrain such as that in West Cork. In such a situation, it is necessary to employ a number of low-power 'fill-in' transmitters, which re-route the signal from the main transmitter to the desired service area.

The main MMDS transmitter operated by Irish Communications in MMDS Cell 28 is located at Nowen Hill. The proposed wind turbine array at Mullaghmesha, approximately 5 km west south-west of Nowen Hill, is directly in line between Nowen Hill and Bantry. Because of the topography, and the requirement for direct line-of-sight to the receiver, the MMDS signal to Bantry however is routed via Ardrah, approximately 5 km to the North of Mullaghmesha. In this configuration, the likelihood of interference with 2.5 GHz MMDS transmissions is minimal.

Point to Point Microwave Links Interference

Microwave signals will be disturbed by wind turbines, as they will by any physical obstruction. It is necessary therefore to ensure that such structures do not compromise existing or planned networks. In this endeavour we have contacted a number of organisations who may be operating or currently planning such links.

RTE operate a network of point to point microwave links to support their terrestrial broadcast network. At this time however, they have not established a microwave link that passes Mullaghmesha.

As well as transmitting at 2.5 GHz, **Irish Communications** operate a number of 6 GHz microwave point to point links between their MMDS cells. While the transmitter at Nowen Hill is connected to this network, no link operates through Mullaghmesha.

The **Electricity Supply Board** operates a national network of point to point microwave links, which are use for the voice and data communications. The ESB have confirmed that they do not operate a link through the proposed wind turbine array at Mullaghmesha.

Eircell and **Esat Digifone** both operate a point to point microwave network to support their mobile communications systems. The Nowen Hill site forms part of this network, but in neither case do direct point to point links cross Mullaghmesha.

Interference to Other Known Transmitters

Located within the area of the proposed wind turbine array is an UHF "deflector" TV transmitter operated by South Coast Community TV. This mast is an active deflector, which receives UHF signals from a transmitter located in Carrigaline and re-transmits them in the general direction of Bantry and Skibbereen.

The antenna which are used to receive and transmit the signals are on a 15m mast. It is proposed to surround this mast with a number of wind turbines, the nearest of which would be approximately 200m to the east.

The wind turbines are arranged in a number of columns that run parallel in a north-west to south-east orientation. Within a column, the wind turbines are separated by approximately 200 m, while the columns themselves are separated by about 450 m. The fibreglass blades are approximately 20m in length, of which there are three on each wind turbine.

It was not considered appropriate by the developers of this project to approach the operators of this deflector system to request precise details of transmission frequencies and other technical parameters. In the absence of such specific information it is impossible to accurately predict the level of interference which may result.

However, configurations similar to this has been investigated by a number of research groups and their findings would suggest that there is a reasonable likelihood that the signals transmitted from this mast will be subject to interference. This situation is all the more likely, given that the signals originating in Carrigaline will be subject to interference before they reach the receiving antenna, and after their re-transmission.

AVOIDANCE, REMEDIAL, OR REDUCTIVE MEASURES

It is the objective of the wind turbine array developer of this site to provide solutions to eliminate any potential impact that the development may have at the existing site. To carry out such a detailed analysis of potential disturbances which could be caused to the UHF signals presently being transmitted from the mast at Mullaghmesha requires some information which is presently not available, namely:

- Transmitter power level.
- Transmitter frequencies
- Transmitter antenna characteristic
- Location of dwellings receiving signal.
- Field strength of signal at receiving antenna.
- Receiving antenna characteristic

Once these facts become available, it will be possible to engineer solutions which will be based on established RF principles.

It is expected that those houses in the immediate vicinity of the turbines will require some remedial measures. In practice, such measures as antenna relocation, etc., are relatively inexpensive and shall be undertaken by the developer.

MONITORING

Emission measurements will have been carried out on the turbine prior to their location on the site, and it is not planned that such measurement will be repeated.

The existence of any interfering signals which emanate from the proposed wind turbine array and which disturbs existing electromagnetic based communication systems will be apparent to any service provider which suffers from such interference. While such an event is wholly undesirable, by its nature it will provide effective real time monitoring of any potential interference.

CONCLUSIONS ON ELECTROMAGNETIC EFFECTS

At this preliminary stage it is not possible to quantify the exact degree of interference which will be caused to electromagnetic signals as a result of the proposed development at Mullaghmesha.

Concern regarding interference to point to point microwave links can be eliminated due to the absence of such links in the intersecting Mullaghmesha.

The most likely cause of interference is that which will degrade the UHF TV signals that are currently being broadcast from an area within the proposed development. This will be remedied in conjunction with the deflector operators.

HEALTH AND SAFETY

THE RECEIVING ENVIRONMENT

The site is at a distance from any residential areas, but there are a small number of scattered residences in the local area. On site, people exposed would be wind farm personnel, and landowners and turf-cutters making occasional visits.

RELEVANT CHARACTERISTICS OF THE PROPOSAL

Wind turbines are tall structures, with large rotating parts, and a considerable amount of associated electrical equipment.

POTENTIAL IMPACTS OF THE DEVELOPMENT

Wind turbine generators, in common with other energy plant, can pose some risk of danger in the event of a failure. Generally, the risk of a serious structural failure is considered to be relatively low. Risks can include tower collapse; or blades, blade fragments, or ice from blades becoming detached and being thrown long distances. Electrical failures resulting in, say, equipment becoming live, or resulting in fire, is also a possibility. A small amount of electro-magnetic radiation is emitted by the generator; this is no different to the electro-magnetic radiation emitted by any electrical equipment, or any other generator. Levels have been measured by appropriate certification bodies, as discussed below, are generally contained within the nacelle, and are within requirement for health and safety regulations - even for someone standing next to them during operation, although this event is unlikely. The nearest any member of the public could get to the generator is 40 - 45 m away, on the ground.

AVOIDANCE, REMEDIAL OR REDUCTIVE MEASURES[17]

The minimum desirable distance between wind turbines and occupied buildings, calculated on the basis of visual impact and expected noise levels, will always be greater than that necessary to meet safety requirements.

Adequate clearance of structures from overhead lines should be provided. In this case, all electrical connections are carried by underground cable.

The height and movement of wind turbines may distract drivers of motor vehicles. A prudent approach should therefore be taken to the siting of turbines near roads with a bad accident record or carrying significant levels of traffic. Accordingly, a setback from the road will be advisable. Such a setback may be up to 300 m, depending on the circumstances. In this case, the distance to the nearest third class road is 1 km.

No avoidance/remedial/reductive are required for levels of electro-magnetic radiation, since these are not in any way likely to lead to health effects.

LIKELY IMPACTS OF THE DEVELOPMENT

According to Paul Gipe[18], "...no member of the public has ever been injured by a wind turbine." Quoting "Swiss analyst Andrew Fritzsche, the operation of wind turbines is 'practically risk-free for the public.' In contrast to other energy sources, renewables 'have practically no

potential for severe accidents' that would endanger the public." It has been estimated that the risk of being hit by turbines or turbine parts is comparable to that of being hit by lightning, within 210 m of a turbine, and considerably less beyond that.[19] Experience indicates that properly designed and maintained wind turbines are a safe technology.

The very few accidents that have occurred involving injury to humans have been caused by failure to observe manufacturers' and operators' instructions for the operation of the machines. There has been no example of injury to a member of the public, only to operational staff. The only source of possible danger to human or animal life from a wind turbine would be the loss of a piece of the blade or, in the most exceptional of circumstances, of the whole blade. Many blades are composite structures with no bolts or other separate components. Blade failure is therefore most unlikely. Even for blades with separate control surfaces on or comprising the tips of the blade, separation is most unlikely. The build-up of ice on turbine blades is unlikely to present problems. If it did occur, most wind turbines are fitted with vibration sensors that can detect any imbalance that might be caused by icing of the blades; so operation of machines with iced blades could be inhibited.[20]

The blades used by BONUS are type LM 19.1, manufactured by LM Glasfiber. It is confirmed that, with over 2000 of these blades manufactured to date, neither BONUS nor LM Glasfiber have received any record of lost blades or parts of blades.[21] The blades are certified by the Danish type approval regulations, under the German regulations governed by Germanischer Lloyd, and according to Dutch type approval regulations.

BONUS also confirms that, to date, neither they nor the suppliers of their towers, E. Roug A/S and VL Stål A/S, have received any record of damaged towers for BONUS 600 kW turbines. This type of tubular steel tower has been used throughout the history of the wind industry.

Copies of certification from recognised Independent Certification bodies are available on request as follows:

- BONUS Energy A/S has been ISO 9001 certified by Det Norske Veritas.
- the BONUS 600 kW Mk IV turbine has been type approved by Risø (not yet translated into English, as it is so new) and by Det Norske Veritas
- a test report on the BONUS 600/120 kW Mk IV wind turbine regarding the production of Electro-Magnetic Radiation
- the NEG Micon A/S M1500-600/150 kW has been type approved by Risø
- the Nordex Balcke-Dürr GmbH N43/600 kW has been assessed and approved by Germanischer Lloyd. This certification was carried out according to the *Regulation for the Certification of Wind Energy Conversion Systems* of Germanischer Lloyd, 1993 edition with Supplement No. 1, March 1994.

The type certificate is based on the:

- Statement of Compliance for the Design Assessment. The design meets the technical criteria of the *Regulation for the Certification of Wind Energy Conversion Systems* of Germanischer Lloyd, 1993 edition with Supplement No. 1, March 1994, concerning the analysis and design of the components of the system. The Design Assessment is based in the calculations and fabrication drawings listed in the relevant certification reports, including:
  - Load Assumptions
  - Safety and Control System
  - Rotor Blades
  - Machinery Components
  - Electrical equipment

- ❖ Tower
- ❖ Commissioning

- ➢ Certificate for the Quality Management System

- ➢ Statement of Compliance for Prototype Testing of Wind Energy Conversion Systems, approved by Germanischer Lloyd. (Power performance evaluation measured by Ingenieurbüro für Windenergie and validated and certified by Risø. Fatigue loads measured by Ingenieurbüro für Windenergie and validated and approved by Germanischer Lloyd. Both were in conformation with the IEA *Recommended Practises for Wind Turbine Testing and Evaluation*, No. 1 *Power Performance Testing* and No. 3 *Fatigue Loads*.)

- the noise power level of the Nordex Balcke-Dürr GmbH N43/600 kW has been tested by Acoustica A/S
- Vestas Wind Systems A/S has been ISO 9001 certified by Germanischer Lloyd GmbH
- a test report on the determination of the sound power level from the Vestas V47-660 kW
- certification of the Vestas 600 kW wind turbine electrical characteristics

In addition, the following has also been included:

- a copy of a Vestas comment on the effect of their turbines on Electro-Magnetic Radiation
- a Vestas document on Environmental Impact Assessment
- a Vestas lightning protection brochure

CONCLUSIONS ON HEALTH AND SAFETY IMPACTS

The minimum desirable distance between wind turbines and occupied buildings, calculated on the basis of visual impact and expected noise levels, will always be greater than that necessary to meet safety requirements.

Extensive operational experience has shown that the wind turbine health and safety record is exceptionally high, probably having a better safety record than many other forms of electricity production. The literature referred to supports this, as do the extensive testing and approval records. No member of the public has ever been injured by a wind turbine.

It should be noted that electricity from fossil fuel sources, e.g., coal, oil, etc., produce emissions that have a negative health aspect. This has been quantified by a major EU funded study (ExternE, DGXVII).

FLORA

THE RECEIVING ENVIRONMENT

General Topography of the Area

The survey area (IRG: W/0850), lies to the NW of Drimoleague and consists of upland, undulating blanket bog surrounding two, small, acidic loughs (Coomanore Lough & Lough Agower), with the ridge to the north dominated by the peak of Mullaghmesha.

While the site itself is not planted with forestry, a NW orientated plantation at Baurgarriff terminates just short of the southern site boundary at the point where a small crater-shaped lake is situated. Here also, a west-to-east running stream fills a trough-like depression, and eventually dips south-eastwards to Castledonovan Bridge, while a rough track runs northwards through Glanclogha and terminates at C. 410m, just to the east of Coomanore Lough.

A second conifer plantation occurs near the SW corner of the survey area at Tooreen South and a rough path skirting this woodland terminates near to the south-west corner of Coomanore Lough.

The Mullaghmesha upland area is surrounded about its western base (the catchment area of the Little Mealagh River) by a patchwork of re-seeded Rye Grass pasture, and alternating, relict, marshy pastures which are infested with Soft Rush. The same situation exists on the SE periphery in Castledonovan Glen and on the southern flanks of the area as well.

The Flora Communities and their Ecology

The site was visited for a detailed survey on November 29th. . The following account is based primarily on that survey.

The undulating upland habitat of the site largely consists of blanket bog, with redundant and active turf-cutting sites in evidence at various points, such as near the western end of Coomanore Lough, and in the Glanaclougha area to the south-east of the lough. Such secondary blanket bog habitats are dominated by coarse growths of Purple Moor Grass and Soft Rush, associated with Marsh Thistle, Arcuate Jointed-rush, Sharp-flowered Jointed Rush and Bulbous Rush etc., in damper areas.

The more natural sections of the blanket bog hold a typical flora, the drier sites with an abundance of the sub-shrubs, Ling, Bell Heather, Bilberry and Western Gorse, together with Tormentil, Heath Bedstraw, Hard Fern and Moor Sedge, while Pill Sedge, Sheep's Fescue Red Fescue and Heath Rush occur more locally as on the northern margin of Coomanore Lough and ENE of Lough Agower on the lower rocky outcroppings of Mullaghmesha overlooking Castledonovan Valley.

In contrast to the drier ground, the wetter valley hollows and runnels on the site hold an abundance of Sphagnum moss, Deer Grass, Cross-leaved Heath, Bog Asphodel, Arcuate Jointed-Rush, Carnation Sedge and common Yellow Sedge, associated with smaller quantities of Marsh, Common Bog Cotton, Bulbous Rush and Devil's-bit Scabious, etc.

Lough Coomanore & Lough Agower

A detailed survey of theses two lakes and their immediate surrounds revealed the most diverse floral range on the site as a whole. Situated roughly centre of the survey area, these two loughs provide quite contrasting features, substrates and floras while overall they add considerably to the ecological, floristic and aesthetic value of the site. A feeder stream from the smaller Lough Agower flows into the eastern end of Coomanore Lough and exits at its western end, descending into the valley, eventually joining the Little Mealagh River.

Coomanore Lough: At an elevation of 386m this is the larger, more imposing and floristically rich of the two loughs. The floor of the lough, especially at its eastern end, is a firm-bedded gravel substrate, which provides a habitat for Shoreweed, Water Lobelia, Intermediate Water-Starwort, Alternate Water-Milfoil, various species of Pondweed and a Water-Crowfoot. The two latter groups, without their associated fruiting parts were unidentifiable to species level.

The paludal margins at both the western and eastern margins of the lough hold an abundance of Lesser Spearwort, Cuckoo Flower, Carnation Sedge, Common Yellow Sedge, Creeping Buttercup, Wild Angelica, Water Horsetail, Bog Stitchwort and Bulbous Rush, etc. Many of these paludal species are more typical of lowland marshland habitats, suggesting that the base-status of Coomanore Lough is higher than one might expect for a montane tarn.

Lough Agower: This, the smaller of the two loughs is little more than a large saucer-shaped, peat-bottomed depression. It is fringed by a floating matrix of vegetation which forms its banks. The latter is dominated Sphagnum moss, with small stands of emergent Bottle Sedge and some Marsh Violet etc. Soft Rush is more common on the firmer peripheral areas of the lough margin. The small rocky outcrop on the SSW side of the lough provided a microhabitat for a few additional terrestrial plants such as Fir Clubmoss (a montane fern-ally) and Hay-scented Buckler-Fern (a woodland species), both of which occur here very sparingly.

The terrain between both loughs (and continuing northwards to Mullaghmesha spot-height) forms stepped, table-like plateaux of wet peat, with Purple Moor Grass and Deer grass as co-dominants, along with scattered populations of other Cyperaceae, such as Flea Sedge, Moor Sedge, Carnation Sedge, Common Yellow Sedge as well as Common Cotton Grass, Arcuate Jointed-Rush, Sharp-flowered Jointed Rush and Cross-leaved Heath etc.

East of Lough Agower, on the SSE slopes of Mullaghamesha, the steeper drier, thinner beds of weathered peat hold more localised species such as Pill Sedge, Sheep's Fescue and Common Dog Violet etc.

Woodland Indicator Species: Although, deciduous woodland is now absent from the site, the frequency of Great Wood-Rush on the eastern slopes of Coomanore Lough (a characteristic dominant or co-dominant herb of acid woodland soils), and its occurrence also on rock outcrops bordering Lough Agower, suggest that this area may have been wooded in former times. Other woodland plants present in the area in very small quantity are Broad Buckler-Fern, Scaly Male Fern (northern shore of Lough Coomanore) and Hay-scented Buckler-Fern (Lough Agower). The arboreal element of such woodlands would probably have consisted of Sessile Oak, Mountain Ash, Downey Birch, Holly, Honeysuckle and Common Ivy. Today, the only area on the site supporting a shrub community lies immediately south of Glanaclogha. Here the mono-dominant shrub, Eared Willow, occurs in abundance in the west-east running stream gully, as well as slightly further west in a ditch-type habitat. The latter lies in an area of abandoned peat cutting not far from the small crater-like lough, which lies just outside the southern site boundary.

POTENTIAL IMPACTS OF THE DEVELOPMENT

The potential impacts of the wind farm on the flora and botanical habitats are listed below:

- Removal of some areas of deep peat community in some areas designated for tracks and wind generators
- Slippage and/or erosion of peat-banks, following roadway construction in areas of deep peat.
- Damage to bog communities due to off-road excursions by heavy work vehicles.
- Fragmentation of formerly viable ecological units, following on construction of the track network linking the generators.
- Drying out of peat communities bordering newly cut sides of tracks resulting in a depauperate flora in such habitats.
- Visual/structural degradation of the topography and plant habitats in the vicinity of Coomanore Lough and Lough Agower.

AVOIDANCE, REMEDIAL OR REDUCTIVE MEASURES

Where roadways are routed through areas of deep peat, the marginal embankments should be gently sloped and re-planted with locally occurring heathers, in order to reduce the possibility of erosion.

The movement of construction and associated vehicles should be carefully planned in advance with a view to minimising their incursions on to the site and confining these to the immediate line of the proposed roadway when the latter is finalised. As the new roadway is excavated, all subsequent movements on these areas of the site should be on the new roadways. Post-construction all vehicular movements on site should be confined to the roads. These measures will protect the delicate structure of the bog-surface from compression damage.

LIKELY IMPACTS OF THE DEVELOPMENT

The excavation of roads will result in the removal of a relatively small amount of the blanket bog habitat present. However, provided the area between the two loughs is avoided, botanically the most interesting area will be preserved.

Given that the general site is dominated by one main habitat type, i.e., upland blanket bog in various states of wetness, the construction of the proposed roadways through it will not cause serious fragmentation of the remaining portion or lead to its non-viability. There is likely to be some local drying adjacent to roadways, especially where these coincide with deeper peat, resulting in a change in species composition to a more dry-heath community with perhaps a somewhat reduced range of species. The confined nature of the latter however, will not detract from the overall value of the site.

Given that the site was assessed in November there is the possibility that some rarer species might have been overlooked and this is why in tables 4 & 5 a list of the more important species possible or likely to be present at other seasons is presented. This list doesn't, however, contain any very rare species, and this combined with the absence of botanically scarce micro-habitats would indicate that the risk of the development endangering a rare plant species is considered remote.

MONITORING

Some degree of botanical monitoring would be desirable, particularly in the area of re-instatement of the road margins, so that in the event of excess erosion further remedial measures could be adopted.

PLANT SPECIES LISTS

Note: Localities are given for extremely localised species. Lowland plants such as Foxglove, Common Gorse, Lesser Knapweed Bramble and Cocksfoot Grass, which area scattered around the lowland periphery of the site, but do not form part of the montane flora, are indicated with 'MLS' (marginal lowland species).

TABLE 3: PLANT SPECIES RECORDED AT THE MULLAGHMESHA SURVEY SITE (29/11/97)

Scientific Names	Common Names
Agrostis capillaris	Common Bent
Angelica sylvestris (Coomanore L.)	Wild Angelica
Blechnum spicant	Hard Fern
Callitriche hamulata (Coomanore L.)	Intermediate Water-starwort
Calluna vulgaris	Ling
Cardamine pratensis	Cuckoo Flower/Lady's Smock
Carex binervis	Moor Sedge
C. panicea	Carnation Sedge
C. pulicaria	Flea Sedge
C. pilulifera	Pill Sedge
C. rostrata (L. Agower)	Bottle Sedge
C. viridula ssp. *oedocarpa*	Common Yellow Sedge
Centaurea nigra (MLS)	Lesser Knapweed
Circium palustre	Marsh Thistle
Dactylis glomerata (MLS)	Cock's-foot Grass
Digitalis purpurea (MLS)	Foxglove
Dryopteris affinis (Coomanore L.)	Scaly Male Fern
D. dialata (Coomanore L.)	Broad Buckler Fern

Table 3 contd:

D. aemula (L. Agower)	Hay-scented Buckler Fern
Equisetum fluviatile (Coomanore L.)	Water Horsetail
Erica cinerea	Bell Heather
E. tetralix	Cross-leaved Heath
Eriophorum angustifolium	Common Cotton Grass
Festuca ovina agg.	Sheep's Fescue
F. rubra	Red Fescue
F. vivipara	Viviparous Fescue
Galium palustre (Coomanore L.)	Marsh bedstraw
G. saxatilis	Heath Bedstraw
Huperzia selago (L. Agower)	Fir Clubmoss
Juncus acutiflorus	Acute-flowered Jointed-Rush
J. articulatus	Arcuate Jointed-Rush
J. bulbosus	Bulbous Rush
J. effusus	Soft Rush
J. squarrosus	Heath Rush
Lobelia dortmanna (Coomanore L.)	Water lobelia
Littorella uniflora (Coomanore L.)	Shoreweed
Luzula multiflora	Heath Wood-Rush
L. sylvatica (both loughs)	Great Wood-Rush
Myriophyllum alterniflorum (Coomanore L.)	Alternate Water-Milfoil
Molinia caerulea	Purple Moor Grass
Narthecium ossifragum	Bog Asphodel
Pedicularis sylvatica	Lousewort
Polygala serpyllifolia	Heath Milkwort

table 3 contd:

Potamogeton genus (both loughs)	Pondweeds
Potentilla erecta ssp. *Erecta*	Tormentil
Ranunculus acris (Coomanore L.)	Meadow Buttercup
R. flammula	Lesser Spearwort
Ranunculus section Batrachium (Coomanore L.)	Water Crowfoot
R. repens (Coomanore L.)	Creeping Buttercup
Rubus genus	Bramble/Blackberry
Sagina procumbens	Procumbent Pearlwort
Salix aurita (Glanaclogha area)	Eared Willow
Stellaria alsine (Coomanore L.) etc.	Bog Strichwort
Succia pratensis	Devil's-bit Scabious
Tricophorum cespitosum	Deergrass
Trifolium repens (Coomanore L.)	White Clover
Ulex europaeus (MLS)	Common Gorse
U. gallii	Western/Dwarf Gorse
Umbilicus rupestris (Coomanore L.)	Wall Pennywort/Navelwort
Vaccinium myrtillus	Bilberry
Viola palustris	Marsh Violet
V. riviniana	Common Dog Violet

TABLE: 4 SPECIES NOT SEEN DURING THE SURVEY BUT WHICH ARE ALMOST CERTAINLY OCCUR

Scientific Names	Common Names
Agrostis canina	Velvet Bent
Anagallis tenella	Bog Pimpernel
Carex echinata	Star Sedge
Dactylorhiza maculata	Heath Spotted Orchid
Drosera rotundifolia	Round-leaved Sundew
Eliocharis multicaulis	Many-stalked Spike-Rush
Eriophorum vaginatum	Hare's-tail Cottongrass
Holcus lanatus	Yorkshire Fog
Isolepsis setacea	Bristle Club-Rush
Juncus conglomeratus	Clustered Rush
Myosotis secunda	Creeping-Forget-me-not
Nardus stricta	Matt-Grass

TABLE 5: SPECIES NOT SEEN DURING THE SURVEY BUT WHICH MIGHT OCCUR ON SITE

Scientific Names	Common Names
Carex curta	White Sedge
C. hostiana	Tawny Sedge
Chamaemelum nobile	Wild Chamomile
Myrica gale	Bog Myrtle
Pinguicula grandiflora	Large-flowered Butterwort
P. lusitanica	Pale Butterwort
Rhyncospora alba	White Beak-Sedge
Saxifraga spathularis	St. Patrick's Cabbage

FAUNA: BIRDS

THE RECEIVING ENVIRONMENT

The site is apparently of the order of 150 ha in extent, and ranges in altitude from 305 m to *circa* 490 m. The terrain is in general fairly level or gently sloping, but includes some steeper ground immediately Southeast of Mullaghmesha peak. No cliffs or rocky crags are present within the site boundary. The most level area forms a central plateau and includes two small freshwater lakes (Coomanore Lough and Lough Agower). The site is underlain by damp peat, and is dominated by rough grasses, admixed with rather sparse, low heather (mainly < 20 - 25 cm in height) and some patches of rushes.

The most obvious existing human impacts on the site are access tracks/roads from the south and (to a lesser extent) north-west, and the presence of up to three metal towers or masts within the site boundary. Well within the site boundary is the mast at the north end of the southern access road, SSE of Lough Agower. This mast is *c.* 30 m in height, supported by guy wires. Another mast, of similar dimensions, is present NNW of here, near (or possibly beyond) the northern boundary of the site. A third, smaller mast, *c.* 7 m is present on the ridge at or near the SW corner of the site.

Other human impacts include moderate levels of peat cutting, mainly near the southernmost tall mast, dating from the current year back at least several years. Associated with the peat cutting and/or with the mast is a moderate amount of ground erosion. Small numbers of sheep were present within the site boundary, and grazing pressure appeared to be low overall, though somewhat higher on the SE slopes of Mullaghmesha (where larger patches of close-cropped grass were present).

RELEVANT CHARACTERISTICS OF THE PROPOSAL

The proposed development involves an electrical sub-station and 16 to 20 wind turbines at altitudes greater than *c.* 350 m, in an array as shown in figure 4. The turbines would be linked by cables in trenches, and by a newly constructed roadway (of 3.5 - 4.0 m width). Existing roadways or tracks (from the south and west) provide access to the site as a whole.

BIRD SURVEY AT THE PROPOSED SITE

Two site visits were made, one to the area of the site (November 20th 1997) and a second to the site proper (November 25th 1997). Ideally, birds breeding at the site would be censused during two visits in the period April-June. However, this was not possible in the present case. Birds recorded during site visits are given their common names in the text and their scientific names are listed in table 6.

SITE VISIT: 20TH NOVEMBER, 1997

An initial visit to the area around and below the site was made on the afternoon of 20th November. Weather conditions were overcast, with a moderate SW wind and good visibility. This visit provided an opportunity to check nearby habitats, especially lakes, for evidence of any major concentrations of birds, and to assess whether any large-scale movements of birds over the site were evident towards dusk. At this time of year, two potential sources of collisions between birds and wind turbines were of particular interest. One possibility was that large numbers of gulls, Curlews or other species might fly over the site in the late afternoon en route to nocturnal roosts, e.g. in

Bantry Bay or at nearby lakes. Another was that concentrations of swan might occur in the area. The Mullaghmesha site itself was not accessed on foot on this visit.

The lower margins of the site, and surrounding areas within about a 5 km radius, were visited and scanned using 10 x 50 binoculars during the period 14:40 - 17:10 h GMT. No waterfowl were present on Kealanine Lough (*c.* 1 km S of the site), while Lough Bofinna (3.5 km SW) held only two Little Grebes. Other lakes were not checked in detail, but no swans or concentrations of waterfowl were visible on any of the lakes scanned at a distance on this date (or on 25th November). No feeding concentrations of swans, wading birds (Charadrii) or gulls were evident on the surrounding farmland. The only concentration of birds noted during this brief survey was a flock of *c.* 140 Fieldfares flying east at low altitude above fields *c.* 1 km S of the site boundary, possibly flying to roost in the conifer plantation abutting the southern margin of the site. No gulls, Curlew or other medium/large bird species (e.g., Starlings or Rooks), were seen flying over or immediately south of the site before dusk, i.e. on this occasion, at least, there was no evidence that the site was below a major roost flight-line.

The only other observation of possible relevance was that of a group of 20 Mute Swans present in Bantry Harbour, close to the town, 9 km SW of the site, along with small numbers (100 - 150) of mixed gull species.

SITE VISIT: 25TH NOVEMBER, 1997

This was the main visit and it was made between 12:00 h and 16:50 h GMT. Weather conditions were mild, with variable visibility (from < 1 km at times to 20+ km), occasional light showers, and a moderate (force 3 - 4) SSE wind. The initial approach was made via the access track from the south. The two lakes and the three masts or towers at the site were accessed on foot, and all other parts of the site were approached to within *c.* 200 m. All birds seen or heard were noted, and note was also kept of heights of flying birds above ground. Initial observations indicated that birds present were few and sparsely distributed, and that attempts to estimate densities using systematic transect methods would not prove worthwhile. The transient nature of avian usage of upland habitats in winter (with many birds moving to lower altitudes in colder conditions) also meant that systematic transect data would not have been informative.

Habitat features noted on this visit are summarised under *'The Receiving Environment'* above. The site appears to provide suitable breeding and feeding habitat for a number of upland or open-country species of birds (see *'Potential Impacts Of Disturbance And Habitat Damage Or Loss'* below). The fairly limited heather cover at the site is not optimal for such species as Red Grouse or Merlin, and no crags or cliffs suitable for nesting by Peregrines or Ravens are present. However, the latter three species could all potentially use the site for hunting, especially if breeding in more suitable habitat within several kilometres of the site.

Seven bird species were observed within, or flying over, the Mullaghmesha site on 25th November, and observations are summarised below. Of these species, five could potentially breed within the site boundaries. Most of the birds observed flew (at least on occasion) at heights < 30 m above ground, and birds using the site would thus clearly be at potential risk from collision with typical wind-turbine structures.

No wild mammals were observed on the site during this visits, but Pygmy Shrews *(Sorex minutus)* and some rodents are likely to occur, providing a possible food source (additional to avian prey) attracting raptors.

Hen Harrier. At least one individual was observed, apparently hunting. At 15:55 h GMT, one bird (of unknown sex) flew up the Mullaghmesha slope near the NE corner of the site, at heights ranging 5 - 15 m above ground. Shortly afterwards, at 15:58 h, a male Hen Harrier flew NE low

across the site, at around the 420 m contour and about 5 m above ground. In plumage, the bird appeared slightly immature (possibly one or two years old, but still capable of breeding).

Golden Plover: A flock of eight birds was flushed from rough grass at around the 420 m contour, and circled calling at 20-30 m above ground for *c.* 30 seconds before flying to a greater height. At least one was heard calling in flight on several subsequent occasions.

Snipe: Three single birds were flushed from damp areas of rough grass or rushes, at altitudes from 370 to 400 m. On each occasion, the bird flew at least 100 m at a height of 5 - 20 m above ground.

Meadow Pipit: Three single birds were flushed from areas of rough grass or heather, each time flying for < 50 m at heights of < 10 m above ground.

Wren: Two single birds were seen (initially heard), one along the base of a sheep fence at *c.* 420 m, the other among tussocks of grass and rushes at *c.* 400 m. On each occasion, the bird remained at ground level and flew only short distances.

Fieldfare: A flock of 12 flew up the SE slope of Mullaghmesha at 15:53 h GMT, near the NE corner of the site, at 10 - 20 m above ground. A further flock, of *c.* 150 birds, flew from the south and landed in rough grass and heather near the southern access track at 16:30 h, at *c.* 380 m altitude. Both flocks are likely to have involved pre-roost gatherings, probably roosting in the conifer plantations abutting the southern or north-eastern margins of the site.

Raven: A single bird was heard calling in flight above *c.* the 350 m contour, not seen but apparently flying at > 50 m above ground.

POTENTIAL IMPACTS OF THE DEVELOPMENT ON BIRDS

Potential impacts of the proposed development on birds can be considered under two main headings:

- *disturbance, and habitat damage or loss* - during construction/installation phase, during site-maintenance visits, and ongoing aural/visual 'disturbance' by the structures themselves;
- *collision or electrocution* - collision with turbines or associated structures (including any above-ground wires and associated power lines, both at and leading away from the site).

Potential Impacts of Disturbance and Habitat Damage or Loss on Birds

The most important potential impact would be on any scarce or uncommon bird species breeding at or near the site. For upland wind-farm sites in general, disturbance may be a more important potential impact on birds. In upland parts of SW Ireland, the most important of such species are birds of prey (especially ground-nesting Hen Harriers and Merlins, or crag-nesting Peregrines), Red Grouse and waders (especially Golden Plover and Curlew). Few quantitative data are available on breeding numbers of these species in the area, but at least four of these species (Hen Harrier, Merlin, Red Grouse and Curlew) are known or suspected to breed in within about a 10 km radius of the site (Sharrock 1976, Gibbons *et al.* 1993). Two of these species (Hen Harrier and Golden Plover) were recorded during the site visit on 25th November (see above). It is important to note that Hen Harriers are among the ten rarest breeding bird species in Ireland, with perhaps only 50-70 pairs in the whole of Ireland (Whilde 1993).

Based on the habitat, altitude, information from the site visits described above, and available published data for SW Ireland, at least 18 bird species can be listed as potential breeding species at the site (although only a small proportion would be expected to breed at any one site). These species are:

Mallard, Teal, Hen Harrier, Merlin, Red Grouse, Golden Plover, Snipe, Curlew, Common Sandpiper, Cuckoo, Skylark, Meadow Pipit, Grey Wagtail, Wren, Wheatear, Ring Ouzel, Mistle Thrush, and Twite. Of these, Skylark, Meadow Pipit and Wren will almost certainly breed here, but a full survey during the breeding season would be needed to assess if any of the others breed. Curlews at least are likely to breed, and Hen Harriers almost certainly will at least feed within the site boundary (even if they breed elsewhere). The site is also very likely to provide nesting or feeding habitat for several additional species not on the list e.g., Ravens (breeding elsewhere). Activities at the site (at least initially) could also, in theory, have some impact on some bird species breeding outside the site boundaries but within range of aural or visual disturbance.

Potential consequences of disturbance would be less significant outside of the breeding season, as few birds will be dependent on the site, and many will feed at lower altitudes in winter, especially during harsher conditions. Disturbance in the period (March to early April) immediately preceding the breeding season of most species could be more significant, however, as some species will be establishing territories.

Potential Impacts of Collision or Electrocution on Birds

A large-scale Californian study at upland wind-farms found 63% of bird casualties were attributable to collision with turbines, 12% to electrocution, 5% to collision with wires, and 20% to unknown causes (California Energy Commission 1995). Collisions can also occur with meteorological towers at wind-farm sites. The risk of electrocution, however, applies to power lines, transformers and substation installations in general, and will not be considered in any detail here - useful reviews are provided by Bevanger (1994), Negro & Ferrer (1995) and California Energy Commission (1995).

In conservation terms, the potential impact of collisions on bird populations is perhaps most important in the case of rare birds of prey, where the loss of even a single breeding (or potential breeding) adult might be significant (at least locally or regionally). Data from upland wind-farm developments in California indicate that birds of prey form a high proportion (65-70%) of the (albeit few) collision casualties that typically occur there (California Energy Commission 1995). The raptor species at particular risk from collisions with utility structures are typically larger species, especially ones that sometimes utilise such structures as hunting perches or even nest-sites. In the case of SW Ireland, the rarer raptor species present would be less vulnerable in these respects (e.g. Buzzards do not breed this far south). However, the potential for collisions, during high-speed hunting flights or during high winds, would still remain for Hen Harriers, Peregrines and Merlins (the rarest three species likely to occur).

In terms of actual numbers of birds involved, the potential for collision might be highest during the winter or spring and autumn migration periods, if large numbers of birds over-fly or pass through the site on migration, en route to roosts or during movements between feeding sites. Losses of migratory or wintering species to collisions would be of lesser conservation concern, except in the unlikely event that large numbers of birds were involved. Larger species such as gulls, Curlews and wildfowl, especially swans, form one broad category at risk. (Swans, given their size and poor manoeuvrability in flight, are particularly vulnerable to collision with utility structures: Birkhead & Perrins 1986). Migratory or pre-roosting flocks of smaller, passerine species such as Starlings or wintering thrushes, could also potentially be involved. Passerines migrating overhead at night (particularly during adverse weather conditions, when flight altitude may be reduced) are sometimes considered to be at particular risk of collision with turbines.

As in the case of breeding birds, few good quantitative data are available for wintering birds in the area around the proposed site, although semi-quantitative data for 10 km squares are mapped by Lack (1986) for the 1981-84 winters. The small lakes within the site boundary (Coomanore Lough and Lough Agower) have not been surveyed during national surveys of wintering waterfowl (Sheppard 1993; Delany 1996, 1997), but notable waterfowl concentrations are unlikely to occur at such small, upland lakes. Of the small lakes within a 10 km radius of the site, only two of the Garranes Lakes (8.5 km ESE of the site) were counted in the 1994/95 or 1995/96 winters, and each held less than 50 waterfowl.

Nearby Bantry Bay is surveyed more regularly, and up to 769 waterfowl were counted in the 1995/96 winter and up to 544 in 1994/95 (Delany 1996, 1997). These totals are small by Irish estuarine standards. Bantry Bay does, however, hold the largest concentration of Mute Swans near the Mullaghmesha site (peak counts in the range 25 - 99 birds in winters 1994/95 and 1996/97). It is not known to what extent, if any, Mute Swans in Bantry Harbour (or elsewhere in Bantry Bay) move to or from sites further inland. A direct line of flight between Bantry Harbour and two lakes (Cullenagh Lake and Coolkellure lake) 17 - 20 km WNW of Bantry would pass straight over the Mullaghmesha site, but such flights may be infrequent or occur along a different route. Another potential major 'risk' species is Whooper Swan, which can occur in large flocks on both pasture and lakes. However, this species is less widespread than Mute Swans in west Cork, and their nearest regular wintering site (typically 30-70 birds) is at the Gearagh, *c.* 28 km to the NE (Merne & Murphy 1986; Delany 1996, 1997). Bewick's Swans do not occur regularly in the area. Of the other large waterfowl wintering in Co. Cork, the nearest population is of Greylag Geese at the Gearagh (up to 57 birds in the winter 1995/96: Delany 1997).

Little information is available on the size or regularity of migratory movements of birds over the site, particularly nocturnal movements (quantitative assessment of which would ideally require radar and/or use of night-vision equipment). However, large nocturnal movements will almost certainly occur on occasion, especially in autumn and winter, based on general observations of migrant and wintering passerines in SW Ireland. In general, such movements will be dispersed over a broad band and at higher altitudes than wind farms or other structures.

AVOIDANCE, REMEDIAL OR REDUCTIVE MEASURES

Disturbance, and Habitat Damage or Loss

Ameliorative measures might include the following:

(a) Minimise initial disturbance to breeding birds by carrying out the main construction and installation work outside of the period April - June, if possible (balanced against the advantage of concentrating work during dry weather conditions to minimise habitat damage).
(b) Use (or improve) existing roads or tracks where possible, to minimise unnecessary habitat damage.
(c) Minimise time spent on site during routine maintenance/inspection visits, e.g. by dividing tasks among several workers where possible.
(d) Minimise or avoid off-road vehicle activity.
(e) Limit, or at least avoid encouraging, public access to site.
(f) Minimise disturbance by aerodynamical or mechanical noise by ensuring use of high quality, well-maintained turbines and/or appropriate dampening measures (cf. Green Power Ltd 1997).
(g) Minimise close-range visual 'disturbance' by using subdued colours on turbine structures (but not blending into background so completely that risk of avian collision is increased) (cf. Green Power Ltd 1997).

Overall, however, the information available on birds breeding at this site is not sufficiently clear-cut to indicate that strenuous mitigating measures are required, although a precautionary approach to such a development is advisable wherever possible. In fact, most of the potential measures itemised above are already incorporated within plans for the Mullaghmesha site.

The timing of the main construction and installation is more difficult to control, given economic pressures for an early start to the development, and the need for suitable weather conditions. Available evidence on the ornithological (or overall ecological) importance of the site is not strong enough to dictate strict limits on timing of the work.

Collision or Electrocution

Ameliorative measures (including those relevant to associated wires or power lines) might include the following (primary source California Energy Commission 1995):

(a) Choose sites away from major avian migratory or other flight (e.g., pre-roosting) routes , and away from large concentrations of birds.
(b) When planning the expansion of existing upland wind-farm developments, or new developments, allow adequate time for full survey of breeding birds before committing to site.
(c) In large-scale developments, build the wind-farm in increments, with monitoring of bird kills after each phase.
(d) Avoid placing structures near water bodies used by waterfowl.
(e) Minimise the height (and rotor dimensions) of turbine structures.
(f) Increase visibility of rotors; this appeared to reduce the number of collisions in an experimental study.
(g) Possibly, group turbine structures within relatively confined areas (subject to aerodynamic/energy-conversion efficiency constraints), e.g., in clusters, rather than in long rows over wide areas.
(h) Minimise, or avoid, illumination of the site and structures at night. Some studies suggest illuminating structures as a way of minimising nocturnal collisions with birds, but other studies warn that such illumination could actually attract nocturnally migrating birds, especially during conditions of low visibility. General evidence from lighthouses and other illuminated structures supports the latter assertion.
(i) Mark any above-ground lines or wires (including guy wires) to make them more conspicuous to flying birds, e.g., by using flags or marker balls.
(j) Use underground power lines wherever possible.
(k) Place any above-ground lines parallel to prevailing wind directions, and lower than main flight corridors, where possible.
(l) In the case of any above-ground power lines or electrical transformers, assess the risk of birds being electrocuted and implement appropriate mitigating measures (details in Bevanger 1984, and Negro & Ferrer 1995).
(m) Monitor avian usage of the site, and collisions or other interactions with turbines and other structures, and implement further mitigating measures if warranted.

Not all such measures may be practicable, for logistical, economic or other reasons, and not all may be useful in a particular situation (e.g. if not warranted by the importance of the site for birds). As in the case of potential disturbance or habitat impacts on birds, the information available on avian usage of the Mullaghmesha site is not sufficiently clear-cut as to dictate that specific mitigating measures are strictly necessary.

Measures *(a), (c), (d), (g)* and *(j)* are probably either unnecessary at this site, or are already in effect incorporated in the development plans. Some of the other measures are also likely to be consistent with existing technical details of the planned development. Consideration will be given to the

practicality or necessity of implementing any remaining measures listed. Of these, measures, *(i)*, involving marking any above-ground lines or wires to reduce collision risks, is probably the most worthwhile special measure.

MONITORING

Once a wind-farm development is in place, some degree of monitoring of interactions with, and possible impacts on, birds is important. The information collected may prove reassuring, if no significant negative effects are detected. Regardless of the conclusions from such monitoring, the data collected will be of value both for the site in question and for other such developments (e.g. by suggesting further amelioration measures). The basic monitoring should be funded by the site developers, possibly by contractual agreement with an independent, scientifically competent and reputable organisation. Another possibility is that additional collaborative research could be carried out by such an organisation, e.g., a University department as part of a post-graduate research project.

In relation to wind turbine facilities in California, Haussler (1988) (in California Energy Commission 1995) noted that "Each wind resource area should be considered specifically to determine (1) the significance of ongoing effects, (2) potential for adverse effects due to future development, and (3) the potential to mitigate and/or avoid adverse effects upon avian populations in the future." This approach is also applicable in Ireland although, at present, the scale of wind-farm developments here is much smaller.

Options for monitoring or related follow-up research include:

(a) As a *minimum*, regular checks for, and accurate identification and quantification of, bird casualties, preferably in some systematic manner (e.g., at regular intervals, and within a defined search radius around each structure) should be carried out. This could possibly be undertaken during routine maintenance visits to the site.
(b) Observations at various seasons (and in various weather conditions) on flight heights and general flight behaviour of birds over site (preferable in comparison with an undeveloped, 'control' site), and of avian interactions with structures.
(c) A study of breeding birds on site, and a 'control' study of an undeveloped but otherwise comparable site if possible, preferably repeated over several years, to assess possible impacts (and the possibility of impacts diminishing over time).

The full extent of such monitoring and follow-up research has not yet been decided in relation to the Mullaghmesha site. If the development proceeds, however, the best way of achieving option *(a)*, at least, will be investigated.

LIKELY IMPACTS OF THE DEVELOPMENT ON BIRDS

Summary of Experience from Wind Farm Developments Elsewhere

Published studies from North America (particularly California) and Europe typically record low average levels of avian mortality at wind farms (California Energy Commission 1995), at least on a turbine-by-turbine basis. The species composition of kills has caused concern in some cases, however, particularly the preponderance of raptors among kills at Californian wind farms. Estimated total numbers of common birds (particularly nocturnal migrants) killed over a year have also been moderately high in some cases.

A more complete assessment of the relevant literature is beyond the scope of the present report, but in summary:

- Mortality rates vary between studies, reflecting a range of factors (not always clear), and extrapolation to particular situations is difficult.
- In general, overall mortality rates attributable to wind-farms are much lower than those attributable to other human causes (e.g., oil-spills, and road traffic collisions).
- Collisions of birds of prey, particularly the rarer species, with wind turbines or associated structures appear to represent the most serious concern in conservation terms.

CONCLUSIONS: IMPACTS ON BIRDS

Taking into account the location and nature of the proposed Mullaghmesha development, experience at wind-farm developments in other countries, available published information on bird populations in the area, and the site visits described above, there is no strong evidence to indicate that this development will have other than a minimal impact on birds. The most significant potential impact would appear to involve disturbance of breeding attempts of, or collision mortality of, a small number of scarce, upland-nesting bird species, most notably Hen Harrier. Given this possibility, and the possibility of avian collision during nocturnal migration, consideration will be given to *avoidance, remedial or reductive measures*, and to the need for ongoing *monitoring*, as noted above.

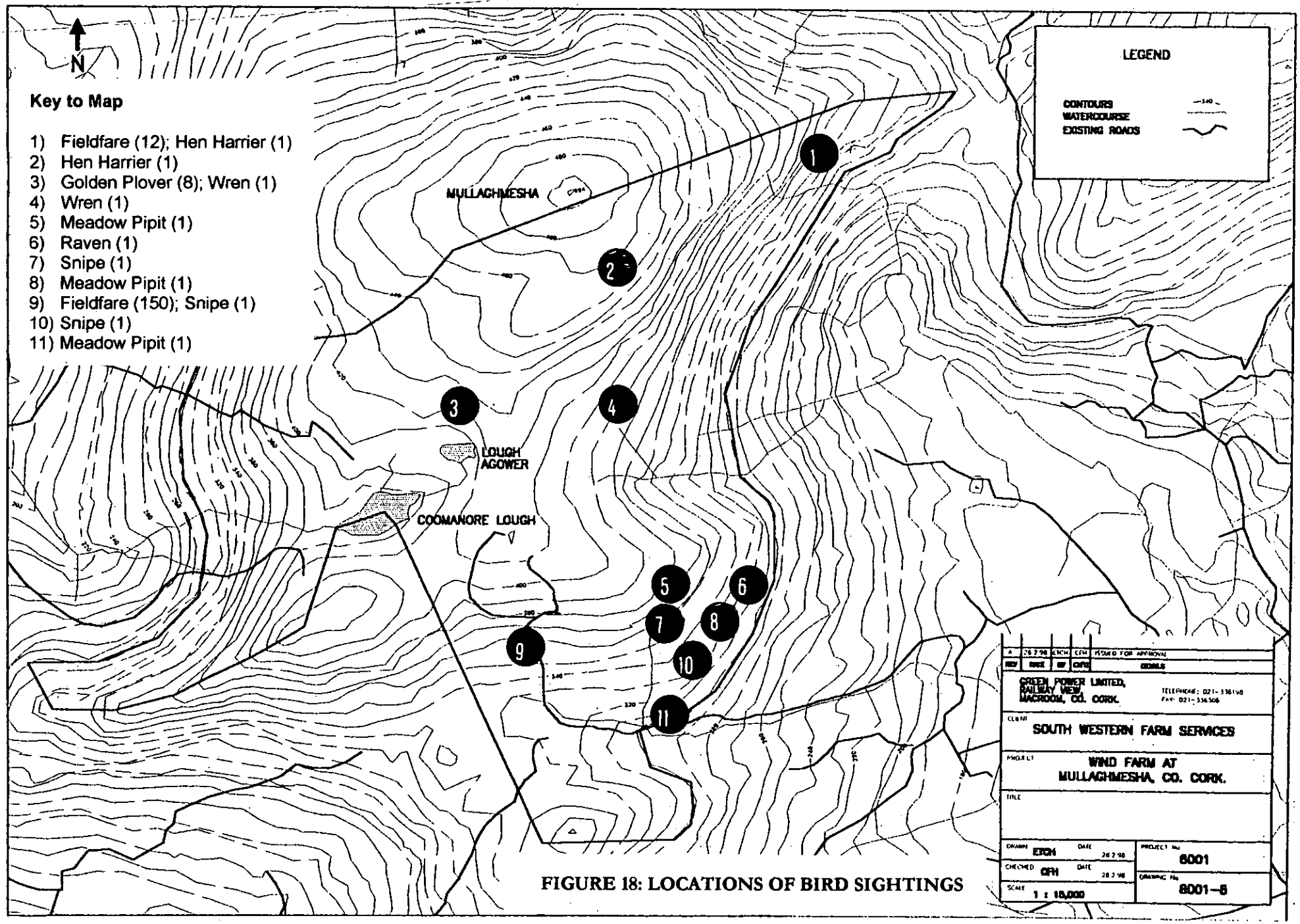


FIGURE 18: LOCATIONS OF BIRD SIGHTINGS

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TABLE 6: BIRD SPECIES - COMMON AND SCIENTIFIC NAMES

A List of Bird Species Mentioned in Text – Common and Scientific Names			
Gulls	Larus spp.	Mallard	Anas platyrhynchos
Curlew	Numenius arquata	Teal	A. crecca
Swans	Cygnus spp.	Hen Harrier	Circus cyaneus
Little Grebe	Tachybaptus ruficollis	Common Sandpiper	Actitis hypoleucos
Fieldfare	Turdus pilaris	Cuckoo	Cuculus canorus
Starling	Sturnus vulgaris	Skylark	Alauda arvensis
Rooks	Corvus frugilegus	Grey Wagtail	Motacilla cinerea
Mute Swan	Cygnus olor	Wheatear	Oenanthe oenanthe
Red Grouse	Lagopus scoticus	Ring Ouzel	Turdus torquatus
Merlin	Falco columbarius	Mistle Thrush	T. viscivorus
Peregrine Falcon	Falco peregrinus	Twite	Carduelis flavirostris
Raven	Corvus corax	Buzzard	Buteo buteo
Golden Plover	Pluvialis apricaria	Whooper Swan	Cygnus cygnus
Snipe	Gallinago gallinago	Bewick's Swan	Cygnus columbianus
Meadow Pipit	Anthus pratensis	Greylag Goose	Anser anser
Wren	Troglodytes troglodytes		

FAUNA: MAMMALS (WITH OBSERVATIONS ON OTHER FAUNA)

RELEVANT CHARACTERISTICS OF THE PROPOSAL

Those aspects of the proposal that might bear some importance for mammals are the construction of a roadway (3.5 - 4.0 m wide) to link up with the 16 - 20 wind turbines positioned around the site. The base of the generators will require a land take in each case of between 7 x 7 and 9 x 9 metres squared. During construction there will be noise from vehicles and human disturbance on site. Post-construction there will be a low level noise out-put from the individual turbines. The site does not form part, either of a proposed NHA (Natural Heritage Area) or SAC (Special Area of Conservation), nor does it adjoin one.

THE RECEIVING ENVIRONMENT

General Site Characteristics with Relevance to Mammals

The site is an upland exposed site dominated by low vegetation, mainly comprising blanket bog with a high cover of Purple Moor Grass. Other vegetation includes rushes, gorse and small conifer plantation (the latter just off-site). There are several small rock out-crops and large boulders throughout the which offer some cover for mammals. A prominent feature of the site are two small freshwater lakes, Coomanore Lough and Lough Agower and two associated streams, one short one connecting them and one more substantial one which exits from the western end of Lough Coomanore. This flows down the steep slopes on the west of the site joining the Little Mealagh river in the valley below. The area is generally windswept and waterlogged in places.

Evidence of human impact on site is relatively low apart from the presence of three masts, a limited amount of turf cutting and some track/roadway. Existing human disturbance therefore can be described as low.

At the same altitude, the surrounding habitat is quite similar, though conifer plantations are more common to the north-east. In the valleys and undulating plains below, habitats comprise relatively small fields and hedgerows, bog land, occasional scrub thickets and small conifer plantations. The hedgerows, small pockets of woodland and scrub areas bordering the margins of the fields provide shelter belts suitable for use by mammals and are of more moderate importance, while the pasture land itself is of little value.

Site Survey for Mammals

The site was surveyed in late November and assessed for habitat type and suitability from the mammal perspective, and mammal signs were noted. Although, this is not the best time of year to survey mammals, given the marginal, upland and exposed nature of the site in terms of mammalian habitat, it is unlikely that a more optimum timing for the survey would alter the assessment results or the conclusions drawn.

Few of the Irish mammalian fauna are believed to be utilising the site of the proposed development at Mullaghmesha. Just two species were confirmed on site during the visit, fox and otter. The otter is a protected species under the 1976 Wildlife Act. Other protected species likely to be utilising the area, in part, include hare and stoat. Badgers are unlikely to occur and no signs of the species were found. Smaller protected species such as wood mouse, pygmy shrew and

hedgehog are likely to be very infrequent if not absent. Unprotected species likely to be using the site include brown rat and rabbit.

Otter field signs were recorded at both lakes on the site. Four otter sprainting sites and eleven spraints (otter faeces) were noted. Of the eleven spraints found, four (36%) were considered to be of recent origin. An examination of the spraints for undigested prey remains identified the prey taken. The frequency occurrence of prey items recorded in the spraints indicated that one (11%) contained the remains of unidentified fish, seven (64%) contained salmonid fish (salmon or trout) and four (36%) contained frog. An examination of the salmonid bones, including vertebrae and maxillae, indicated that modest sized fish were taken; these are assumed to have been brown trout given that salmon are unlikely to have juvenile populations inhabiting the upper reaches of such a small stream. It isn't clear whether the fish were taken from the lakes or from the streams. Frogs are likely to be common on the site explaining their importance in the diet.

Otter holts (their underground resting sites used for breeding) were not located within the survey area. However, there was some evidence of over-ground temporary sites. The lakes, which have a low level of human disturbance are likely to be used as a temporary rest and feeding area for otters utilising the upper reaches of the tributary of the Mealagh river. Although, lowland, riverine, habitat is preferred by otters, these lakes can be considered locally important for the species.

Fox field signs were reasonably distributed on site. In all, six fox scats (faeces) and two urination sites were recorded, mostly near Glandart, Coomanore Lough and Glanaclogha. Qualitative examination of the fox scats for undigested prey remains identified fox prey taken. The frequency occurrence of prey items recorded in the scats were as follows: unidentified mammal in three (50%), bird in one (17%) and sheep remains in two (33%). The mammals taken are likely to be hare, rabbit or rat. The bird was unidentified and the remains may have been eaten from carrion (dead carcasses). There is very little shelter for foxes on site and food resources are likely to be limiting for the species. The pattern of marking and the high altitude of the site indicate that it represents the upper limit to the range(s) of one or two individuals.

Overall Importance of the Site for Mammals

The relatively high altitude of the site (*c.* 305 - 494m), high exposure and low diversity of suitable habitats on the site would significantly limit the density of mammals and their level of utilisation of the site. Accordingly, the site can be generally described as of low importance to mammals.

Other Fauna on the Site

The small stream exiting from Coomanore Lough had a range of macroinvertebrates under stones including a freshwater sponge, stonefly nymphs (Chloroperlidae), uncased caddis fly larvae (Hydropsychidae) and small specimens of the Wandering Snail (*Lymnea peregra*). A cursory examination of the undersides of some of the larger stones in the small stream connecting Lough Agower with Coomanore Lough didn't reveal any macroinvertebrates, although they are certain to be present in deeper gravel substrate there. Although the pH of the water from these streams was not measured it would be expected to be in the range 5.0 to 6.5. Water both in the lakes and the streams was moderately coloured but free of any signs of siltation.

POTENTIAL IMPACTS OF THE DEVELOPMENT

Given the low level of site utilisation by mammals in general, potential impacts are also likely to be minor and are likely to be insignificant. The only exception to this is in the case of otters, which

might abandon the two lakes on the site if access to them were blocked by road construction over the stream, which exits from Coomanore Lough.

Road construction might also lead to siltation of any streams which may be traversed by roads e.g., the outlet stream from Coomanore Lough. In each case this siltation would reduce the diversity of macroinvertebrate fauna present and possibly reduce the level of utilisation of the streams by fish.Disturbance during the construction phase may force otters to temporarily abandon the site.

MITIGATION MEASURES

Any road crossings of streams should be carefully executed so as to reduce the possibility of erosion of the banks or streambed. A small bridge with ledges to allow for the passage of otters should be built if necessary. Willow should be planted to form a shelter-belt on the banks of the stream in the vicinity of any bridge; this will ensure continued unimpeded access by otters to the lakes.

LIKELY IMPACT OF THE DEVELOPMENT ON FAUNA (MAMMALS)

The overall impact development on mammals will be low and cannot be considered significant. The construction of the roadways on site is unlikely to interfere significantly with mammal density or utilisation of the area. The disturbance effect of the construction phase may force otters to temporarily abandon usage of the lake area in the short term. The species will however habituate in the medium term and provided there is no damage to the flow regime to the lakes, will continue to utilise the freshwater habitats on site.

ARCHAEOLOGY

RELEVANT CHARACTERISTICS OF THE PROPOSAL

This report examines the Cultural Heritage of the area of the proposed development and assesses the impact that the proposed development will have on the Cultural Heritage of the area of Mullaghmesha. The study area is located on the southern slopes of Mullaghmesha, 1629 ft OD., in the townlands of Mullaghmesha, Glanaclogha, Glandart and Coomanore South, above the contour line 1000 ft OD. The south-western boundary of the site lies above the 1000ft OD contour line and follows the line of the Union and RD Boundary. Mullaghmesha is located nine kilometres east of Bantry.

THE RECEIVING ENVIRONMENT

Methodology

The following sources were consulted prior to the area being field walked:

1. The Archaeological Inventory of County Cork, Volume 1, West Cork.
2. The S.M.R maps sheets 119 and 106.
3. The O.S. 6ins 1st edition maps, sheets 119 and 106.
4. The files of the Cork Archaeological Survey.
5. The Topographical Files in the National Museum.
6. An aerial photograph of the area of the proposed development.

No archaeological sites are marked on any of the editions of the O.S. maps of the area of the proposed development. No archaeological sites are visible on the aerial photograph. No artefacts are listed in the files in the National Museum. However, a number of archaeological sites, within and adjacent to the area of the proposed development, have been reported to the Office of the Cork Archaeological Survey by a person living in the locality. These sites have been marked on maps and given working numbers by the Survey.

The area of the proposed development was field walked by the archaeologist and exposed turf banks were examined.

Introduction

The area of the proposed development is an upland area ranging in height from 1000-1629 ft OD. The eastern slopes of Mullaghmesha are drained by the Ilen River. The western slopes of Mullaghmesha are drained by Lough Agower, Lough Coomanore and the Little Mealagh River. Much of the higher slopes of Mullaghmesha are covered in blanket bog. An area of working turf banks, averaging 0.7 - 1.3 m high (plate 13), are located to the south-east of Lough Agower and Lough Coomanore. Outcrops of rock are prevalent in the north-eastern section of the area.

A ruined tower house, Castledonovan, is located to the south-east of the proposed area of development on the east bank of the Ilen River. It is built on a rock outcrop. The tower house is very prominent in the landscape when the proposed area of development is approached from the east.

Archaeological Sites

A group of hut sites had been reported to the Survey Office by a person living in the locality. Three groups of hut sites were located on the eastern slopes of Mullaghmesha (see plates 14 - 16 and figure 19) during field walking and surveyed. The hut sites are difficult to date with any certainty for they may date to any period. There is no evidence of mortar being used in their construction. The stone is of an unhewn nature. They may be the remains of huts associated with the practice of transhumance or booleying. They are located in a sheltered area, on a south-east facing slope, at the base of a rock outcrop *c.* 5 m high, in proximity to a water source.

Site 1 CAS 106089

This a group of three hut sites (plate 14) aligned northeast-southwest.. Scattered stone in the vicinity may represent the remains of other hut sites. The huts are lying in a linear fashion and are conjoined. The south-westerly hut is 4.0 m by 3.0 m, the western wall remains standing to a height of 0.7 m. The central hut measures 2.5 m by 2.0 m. The north-eastern hut is 2.0 m in length, the southern wall is no longer extant.

Site 2 CAS 106078

The remains of two hut sites are visible (plate 15). They are located 150 m to the south-west of *Site 1*. The northern hut is only partially intact. It is 2.0 m in diameter. The second hut is located 3.0 m to the south, it is circular in plan, 2.5 m in diameter. The maximum wall height is 0.5 m.

Site 3 CAS 106088

Site 3 is located 105 m north-west of *Site 2*. It differs in plan to *Sites 1* and *2*. A wall, 7.5 m in length, aligned east-west, has survived (plate 16). The western end of the wall is built on a natural rock outcrop. At the western end of wall is a hut sub-circular in plan, 3.0 m N - S by 2.0 m E - W. There is an opening to the east, 0.8 m wide. The maximum wall height is 0.75 m.

Similar hut sites are known from other upland locations. Five were recently located north of Bantry in similar terrain at an altitude of 900 - 1000 ft OD.

A group of archaeological sites are located outside the area of the proposed development, west of the Union and R.D. Boundary. They consist of two boulder burials, an earthwork, a hut site and a standing stone. The sites are located above 1000 ft OD. East of Mullaghmesha in Derreenacrinnig West, situated between 800 - 1000 ft, is a cup marked standing stone, an enclosure and a hut site. None of these sites are marked on any of the editions of the OS maps. They have been reported to the Offices of the Cork Archaeological Survey by people living in the locality. The majority of these sites are prehistoric in date. The presence of prehistoric sites in upland regions in West Cork is not unusual. The number of recorded sites is increasing all the time, particularly in upland areas, as previously unrecorded upland sites are reported to the Cork Survey. The number of prehistoric sites in the vicinity of the area of the proposed development is worth noting. It must also be noted that it is not possible, from a surface examination, to date the hut sites described above to a particular period.

PLATE 13: FROM EAST VIEW OF TURF BANKS

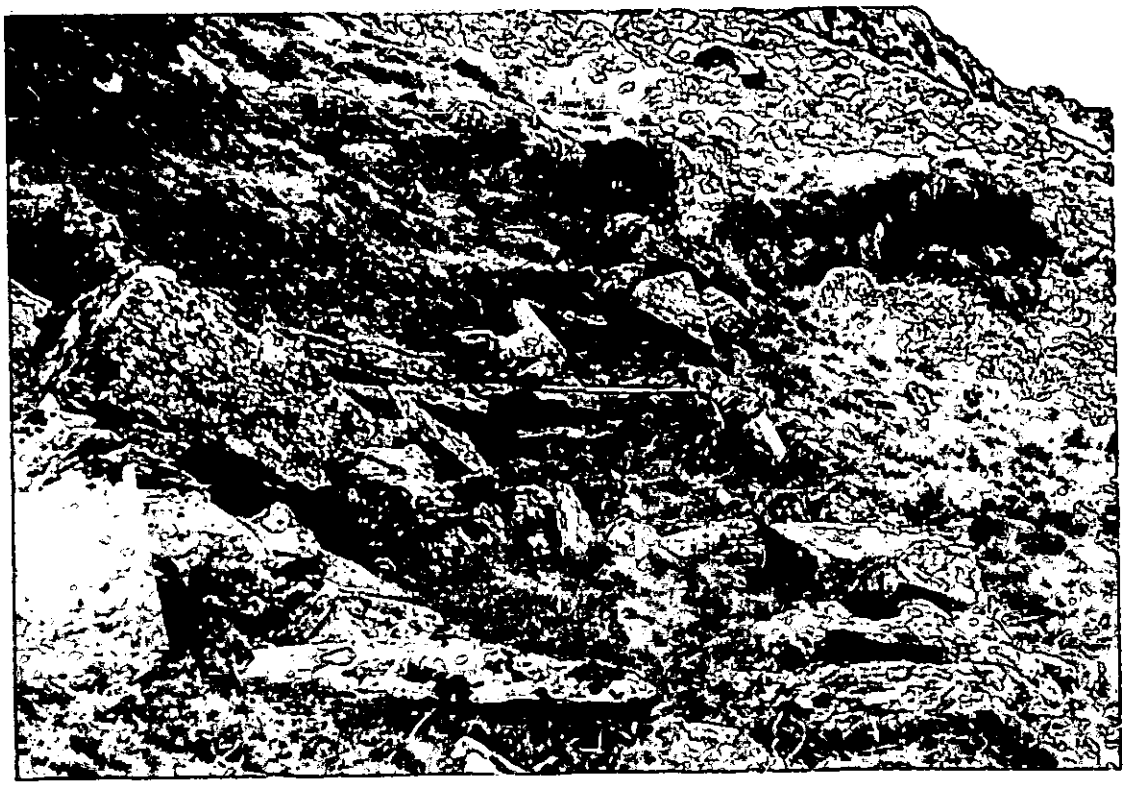


PLATE 14: FROM WEST SITE ONE

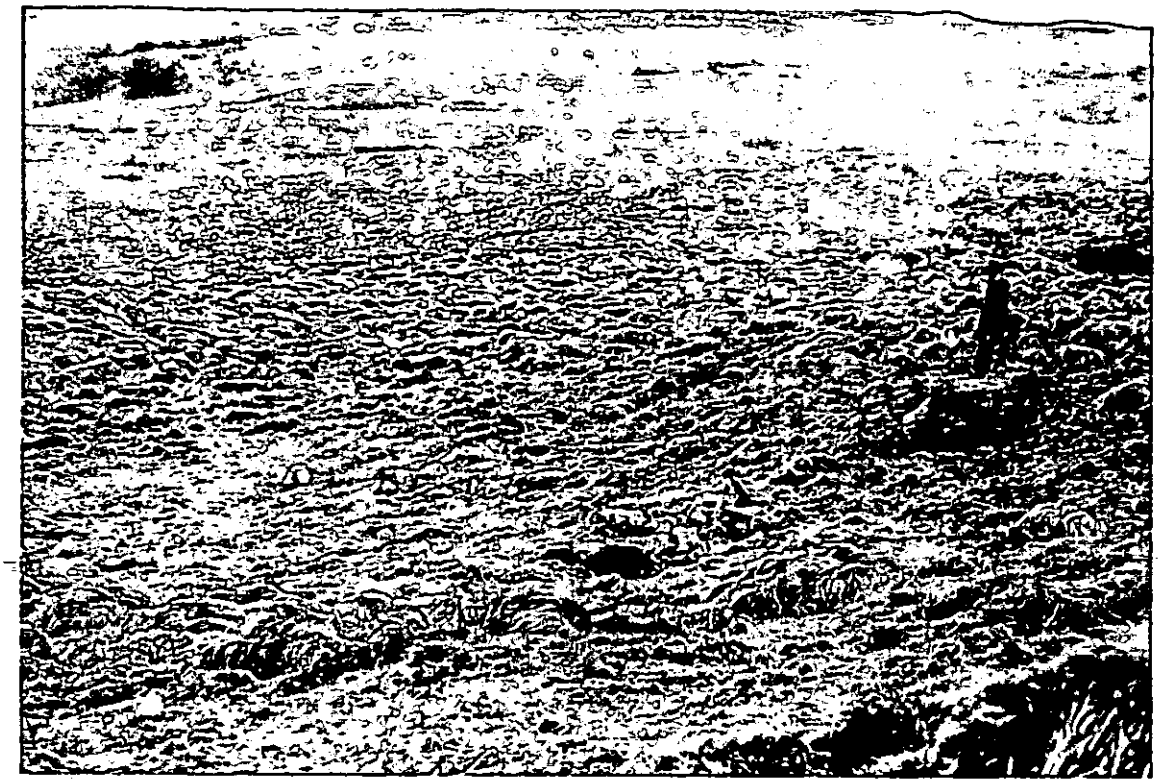


PLATE 15: FROM NORTH EAST SITE TWO

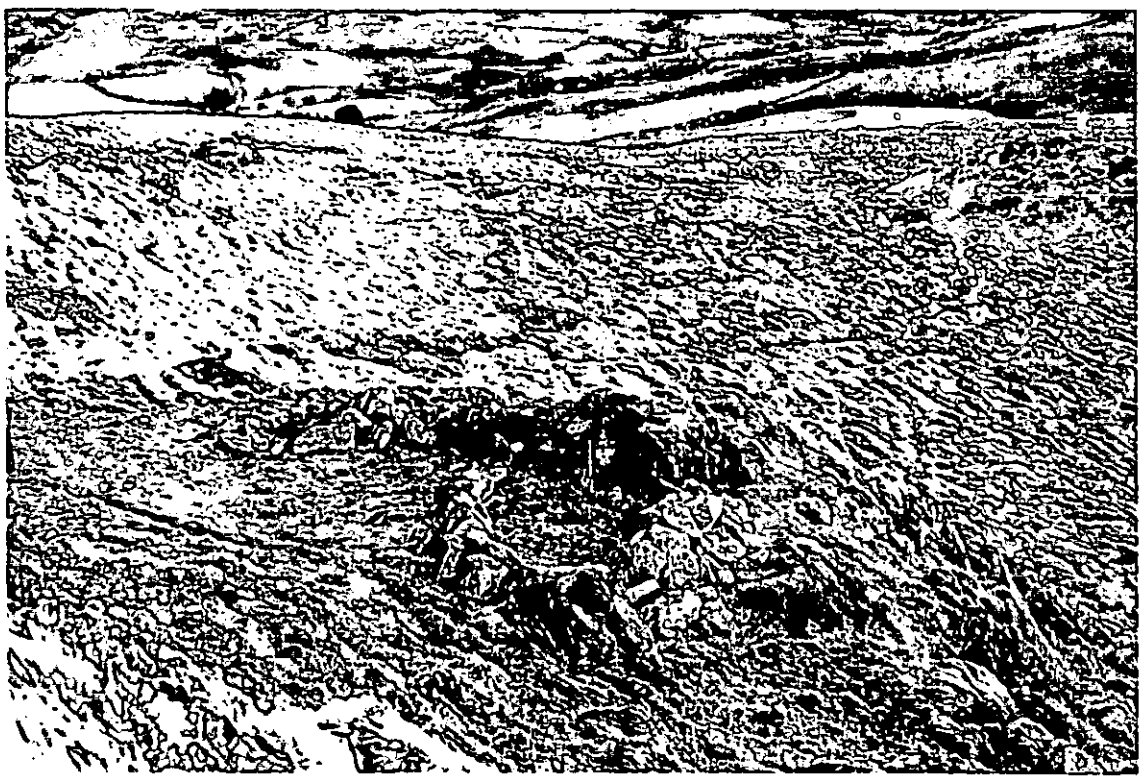


PLATE 16: FROM NORTH SITE THREE

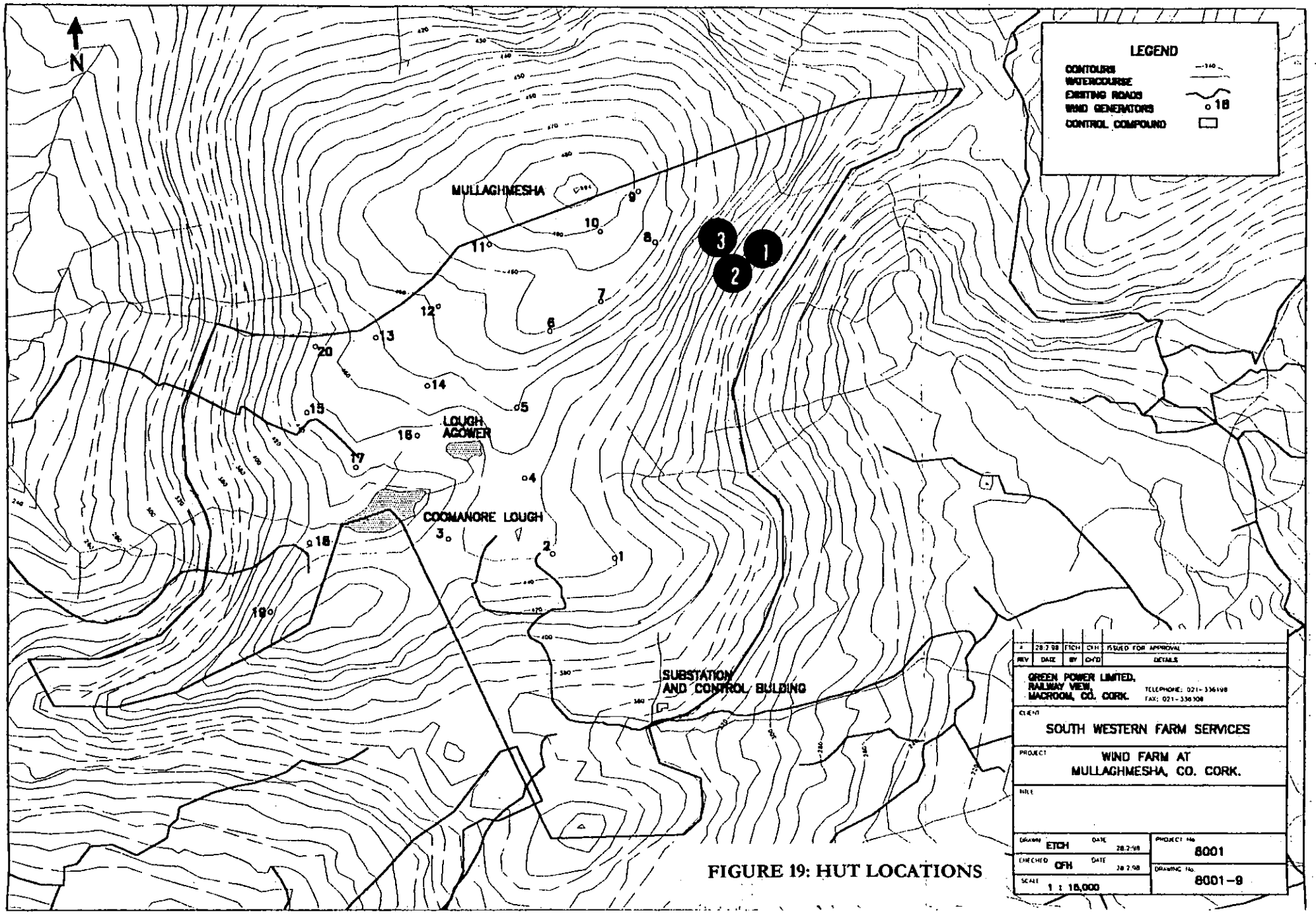


FIGURE 19: HUT LOCATIONS

POTENTIAL IMPACT OF THE PROPOSED DEVELOPMENT

The impact on the Cultural Heritage of Mullaghmesha, from the ground disturbance works associated with the excavations for the proposed roadways, cable trenches and wind turbine transformer sites for the Wind Farm, must be considered in two ways. The proposed development works can have an impact on the known archaeology and the unknown archaeology of the area.

In the case of the known archaeology there are three groups of hut sites located within the site (see figure 19). The ground disturbance works associated with the excavation of the roadway or the cable trench in this vicinity may have a major impact on the hut sites. The original extent of the hut sites can not be gauged from a surface examination.

In any area there exists the potential for buried archaeological sites, i.e., sites with no visible remains above ground. The presence of the groups of hut sites within the proposed area of development coupled with the existence of archaeological sites to the south-west and east of the area of development, at similar altitudes, may serve as an indication of the presence of other archaeological sites within the vicinity. The proposed excavation works could have an impact on unknown archaeological sites that may be located within or beneath the blanket bog.

MITIGATION MEASURES

The impact of the proposed development on *Sites 1-3* would be negated if no development works are permitted to take place within 20 m of the hut sites. The sites would need to be fenced off in advance of commencement of any development works. If a zone of protection were established in advance of development work then the impact of the proposed development on the Cultural Heritage of the area would be minimal. If a zone of protection was not afforded to the recorded sites then it would be necessary to record by excavation the sites in advance of the proposed development.

The impact of the proposed development on the potential archaeology of the area is difficult to assess and to mitigate for. The presence of archaeological sites within and adjacent to the proposed development maybe used as an indicator to suggest that further archaeology may be buried within or beneath the blanket bog, or may be obscured by vegetation cover. The excavation works that will be undertaken within the area of the proposed development should be monitored by a qualified archaeologist so that the presence of any archaeological features and/or artefacts could be recorded and recovered.

The turbine array has been checked with regard to recommendations made. It is clear that no turbine is within the desired 20 m separation distance (figure 19).

MATERIAL ASSETS: TRAFFIC, AGRICULTURE, WASTE AND ELECTRICAL DEMAND

THE RECEIVING ENVIRONMENT

Traffic

The minor public roads approaching the site are third class roads (with a 4.0 m maximum width) which branch from the third class road (with a 4.0 m minimum width), running from Dunmanway to Bantry. Access to the site is from these third class roads (maximum width 4.0 m) to low grade roads classed as "other roads" and on to the farm tracks that lead to the site itself. See figure 2.

Traffic on the third class road (minimum width 4.0 m) from Dunmanway to Bantry is primarily local in nature. Two more significant trip destinations in the nearby area are Castledonavan National School (on the road from Dunmanway to the South Eastern approach to the site) and Lough Bofinna, a popular location for fishing (on one of the two roads from Bantry to the Western and South Western approaches). Other than trips with these two destinations, traffic is generally local.

On the third class road (maximum 4.0 m) connecting the Dunmanway - Bantry third class road to the South Eastern site approach, traffic can be said to be exclusively local in nature, being used only by the few residents and their visitors.

On the third class road (maximum 4.0 m) connecting the Dunmanway - Bantry third class road to the Western and South Western approaches, traffic is almost exclusively local in nature, the main exception being Bantry Riding School, situated near the beginning of both farm tracks to the site.

Agriculture

Currently, the site is being used for sheep grazing and turf-cutting. The land is not suitable for other agricultural uses.

Waste

The waste facilities in the local area are local authority landfill sites.

Electrical Demand

(see report overleaf by Darrell Nightingale)

Under normal operation, the Dunmanway 110 kV transformer station supplies Bantry, Ballydehob, Glengarriff, and Castletownbere. In addition, the Knockearagh (Killarney) 110 kV transformer supplies Kilgarvan and Kenmare. However, under times of peak demand in South Kerry, Dunmanway is also required to provide additional supply to this area, resulting in the severe overloading of the Dunmanway – Bantry line. Additional economic growth is increasing load growth on the National Grid at a rate of 6%. This kind of growth will clearly be difficult to support on this line, so it has been proposed that a new line be built from Dunmanway to Ballylickey. In addition, there is a 10% energy loss on the Dunmanway –Bantry line.

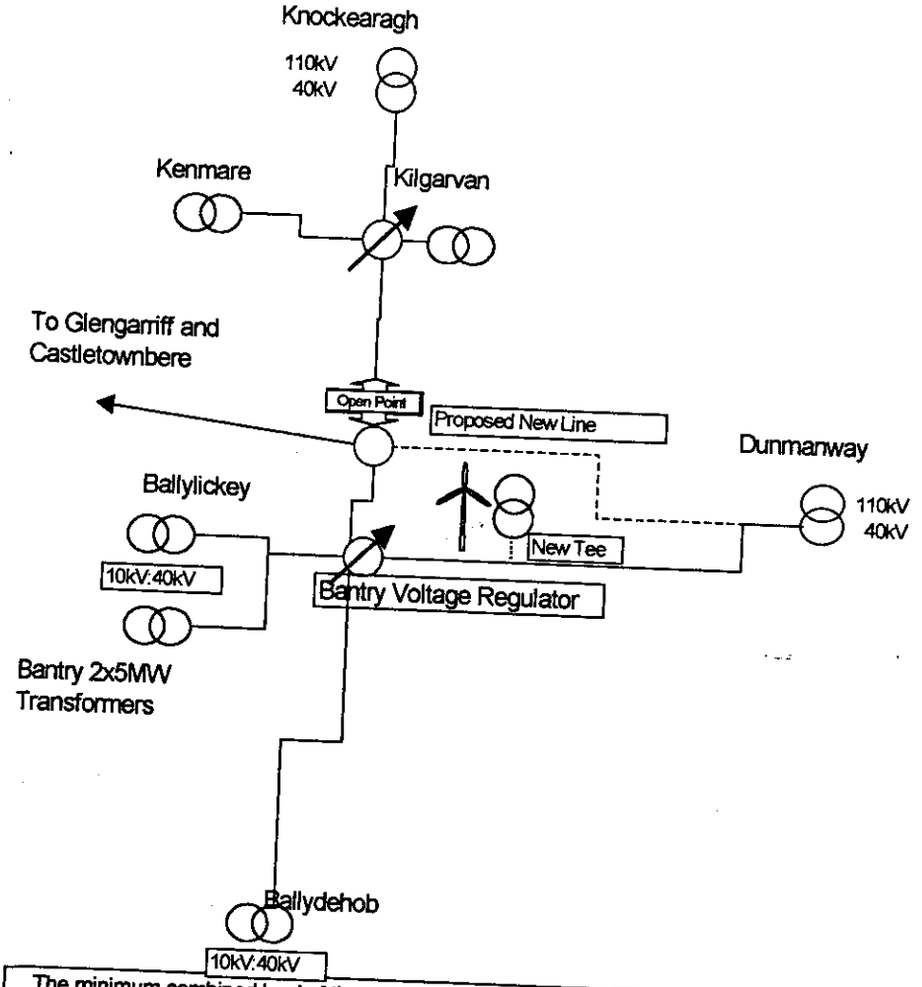
Impact of an 11.5MW Wind Power development at Mullaghmesha, Drimoleague, Co. Cork on the electricity distribution infrastructure

The proposal is for a teed connection into the 40kV line running between Dunmanway 110kV transformer station and Bantry 40kV transformer station. The 40kV circuit, Knockearagh (Killarney) to Dunmanway is diagrammed in the diagram below. Under normal operation Dunmanway supplies transformers (to MV [10/20kV]) situated at Bantry, Ballydehob, Glengarriff and Castletownbere. Under normal operation Knockearagh supplies transformers at Kilgarvan and Kenmare. To achieve this isolation the open point at Ballylickey is open. When this normally open point is closed, all six MV transformer stations can be supplied from either the Dunmanway end or alternatively the Killarney end, allowing a standby-feed arrangement.

The line from Dunmanway to Bantry has become, since its design, severely overloaded due to the very large growth in load. There are economic and technical limitations to the energy and voltage losses tolerable on a line, and these must be seen as near critical on this line, so that a relief line from Dunmanway to Ballylickey has been envisaged.

Normal peak load on the Bantry outlet from Dunmanway was measured under the ESB Altener study at c.9MW. This value is close to the 10MW which would be regarded as the maximum desirable loading of this line, resulting in c.10% drop in Voltage and c.10% Energy Loss (i.e. only c.9MW being received at Bantry). Under standby arrangement, the measured load value rose to c.14MW. Clearly load growth, nationally at c.6%, and increment on Glengarriff is anticipated.

The proposed tee is two thirds of the way from Dunmanway to Bantry, and thus the Wind power output only suffers one third the loss and voltdrop in delivery to Bantry that would pertain to power delivered from Dunmanway.



The minimum combined load of the 4 West Cork transformers normally supplied by this line has been likewise measured to be of the order of 3.5-4MW and this can be expected to rise. The mean output of the Wind power development would be of the order of 4.5-5MW.

The principal effect on the electricity infrastructure would thus be to afford the potential postponement of construction of an additional line to feed West Cork and to reduce losses and improve voltage regulation on the existing line.

RELEVANT CHARACTERISTICS OF THE PROPOSAL

Traffic

There is likely to be one, or at most, two visits from a light four wheel drive vehicle per day. This will be typical of routine operation and maintenance. For repairs, a crane would be required. This is expected to be very infrequent - possibly once a year. If, in unseen circumstances, a crane were required more frequently, it would make most sense to purchase one, and keep it on site, within the compound, meaning that there would then be no trips by a crane to the site.

Agriculture

Agricultural activities will continue as usual.

Waste

Minimal waste will be generated on site. Any such waste will not be allowed to accumulate, but will be brought regularly to authorised local authority waste disposal sites.

Electrical Demand

It is proposed that a connection from Mullaghmesha Wind Farm be teed in to the 40 kV line running from the Dunmanway 110 kV transformer station to the Bantry 40 kV transformer station. (See diagram on previous page.)

POTENTIAL IMPACTS OF THE DEVELOPMENT

Traffic

Generated traffic will be extremely low. Potential impact is consequently low.

Agriculture

The proposed development will occupy 1% - 1.5% of the site area, so that the potential impact is negligible.

Waste

Since nothing material is being produced at the site, and no raw materials for production are being delivered, the main potential impact is from rubbish, replaced parts, and other discarded material accumulating at and around the site.

Electrical Demand[22]

The impact of Mullaghmesha Wind Farm is likely to be most beneficial to the National Grid. Embedded generators (i.e., generators located within the distribution network, supplying local demand) deliver electricity to consumers more directly than centralised generators. The cost of electricity increases as it moves through the system; according to the ESB, the "Pale" area of the National grid is currently effectively subsidising the rest of the country, particularly the west coast, for which it is extremely expensive to supply electricity. This is due to a variety of factors, such as transmission and distribution losses, and institutional factors. Where electricity is generated in closer proximity to the user, reducing the distance over which the electricity has to travel, electrical losses are reduced. The electricity is also delivered either at or closer to the correct voltage for distribution - electrical output from centralised generators must be transformed up to a high voltage, transmitted, and then transformed back down to the lower voltage. Thus, less electricity is lost in transmission and distribution. Also, use of the high voltage transmission network is expensive. Embedded generators do not use it.

Embedded generators can assist in preventing power cuts. Where there is a partial failure on the high voltage network, and demand on the substation is greater than the remaining available line capacity, an operating wind farm can prevent local consumers from being affected.

If there are severe problems with meeting electrical demand in an area, some areas may have to have power switched off temporarily. This is most unlikely to happen in an area with an embedded generator, because of its valuable electricity contribution.

Embedded generation brings most benefit where the transmission and distribution grid is weak, as is the case in West Cork.

Recognition of the value of embedded generation has recently occurred in Germany. It has been calculated that the municipal utility Stadwerke Wuppertal's avoided costs in purchasing renewables was 0.07 – 0.11 DEM/kWh (approximately IR 0.03 p - IR 0.04 p).[23]

AVOIDANCE, REMEDIAL OR REDUCTIVE MEASURES

Traffic

Traffic impact is very low. There is no reason for it to increase significantly; the application of avoidance, remedial or reductive measures does not apply.

Agriculture

Not applicable, since agricultural activities will not be affected.

Waste

Strict management of the site will be required to ensure that no waste gathers at the site.

Electrical Demand

Not applicable, since the effect on the electricity network will be beneficial.

LIKELY IMPACTS OF THE DEVELOPMENT

Traffic

Very low. Although the per centage increase could be viewed as high, the actual number of vehicles involved are so low that it will not induce major changes in the character of road network usage.

Agriculture

Negligible.

Waste

Negligible, once the minimal amount of waste is managed suitably.

Electrical Demand

The development of the wind farm will mean that the proposed new line from Dunmanway to Bantry could be postponed. It will also improve voltage regulation on the existing line. In addition, energy losses on the line will be improved. Electricity from the proposed tee to Bantry would have an energy loss one third of the existing loss. This will reduce the cost of supplying electricity to Bantry, Ballydehob, Castletownbere and Glengarriff proportionally.

There is a proposal for the expansion of an industrial development in the Adrigole area, requiring an increase in electricity consumption from 1 MW to 3MW that would be facilitated by this development.

MONITORING

A monitoring programme can be agreed with the County Council for any of the material assets discussed if so desired.

CONCLUSIONS: IMPACT ON MATERIAL ASSETS

The impact of this development on the infrastructure and land use in the area will be very low for traffic, negligible for waste and agriculture, and will be very beneficial for the national electricity grid.

OTHER IMPACTS

HYDROLOGY

The Receiving Environment

The catchment area affected is approximately 1.3 km^2 at an altitude above 300 m. The average annual rainfall is 2300 mm with a significant bias towards the months between October and March. The catchment characteristics are quantified as soil type 3, S1085 = 4.5, in the Flood Studies Report[24] classification.

Relevant Characteristics of this Proposal

The characteristics of the development relevant to hydrology are the contributions of site roads and turbine foundations.

Potential Impacts of the Development

The only possible hydrological impact of the development is an increase in runoff from a rain storm. This would increase the peak flow to the numerous streams draining the Mullaghmesha plateau. The increase in runoff results from a change in the surface runoff coefficient due to turbine foundation construction and road construction; however, the per centage change is insignificant as the following calculation shows:

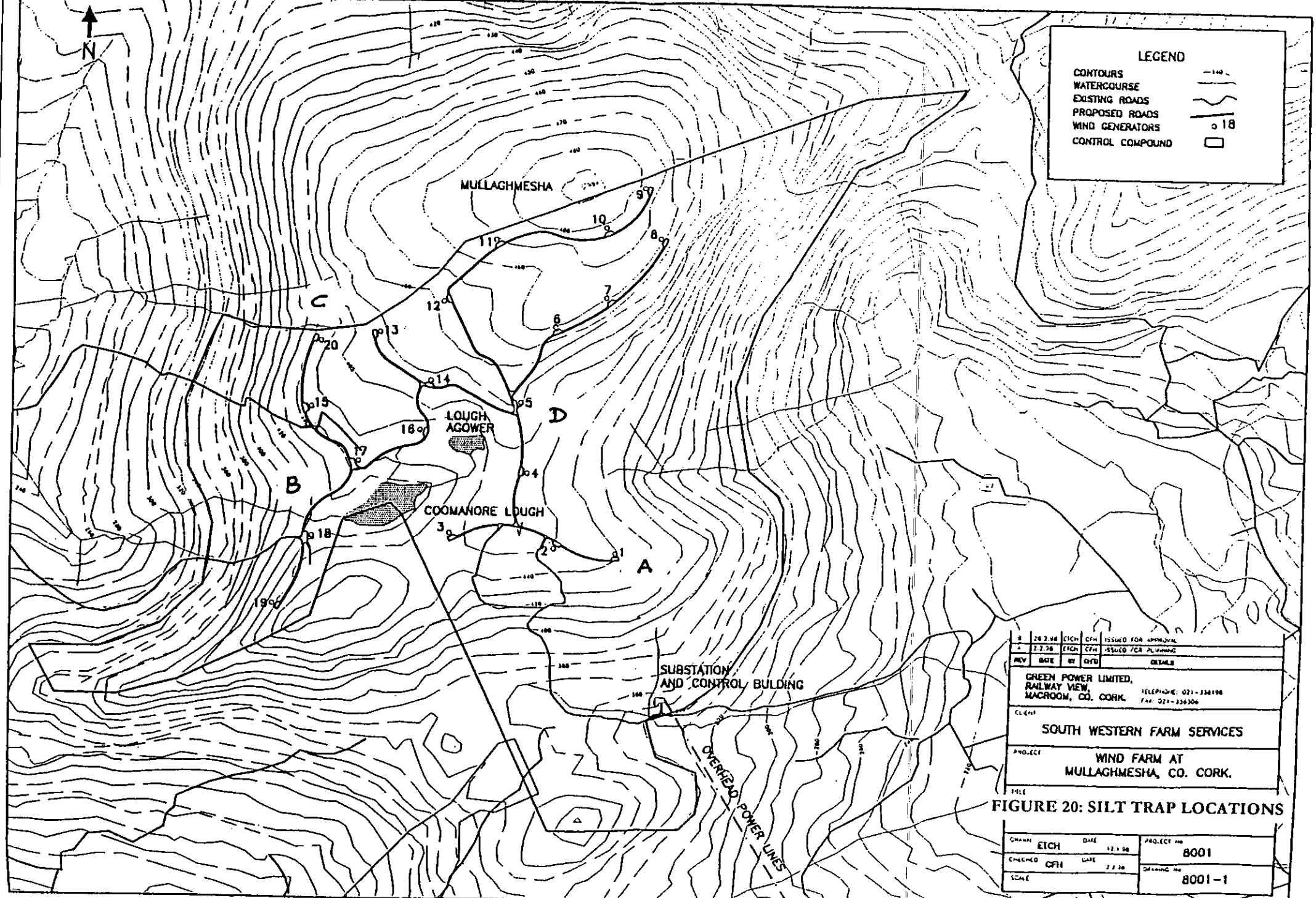
Roads will have a total length of 4.5 km at an average width of 4.0 m.
Total area = 1.6 ha.
A turbine foundation area including crane pad is120 m^2.
For 20 turbines, this gives a total area of 0.24 ha.
The total catchment area subject to an increase in runoff coefficient is 1.84 ha.
The change in runoff coefficient for the turbine foundations will be an increase from what 0.35 to 1.0, and for the site roads will be an increase from what 0.35 to a maximum of 0.5.
The average increase will be 0.56.

For a rain storm with a return period of 5 years, the intensity is estimated at 35 mm/hr with a duration of 40 min. At present, this produces a total runoff of 3.4 m^3s^{-1} for the catchment of 1.3 km^2. This is distributed between five main streams, giving approximately 0.7 m^3s^{-1} per stream.

Foundation and road construction will produce an increase in runoff of 0.01 m^3s^{-1} per stream. This is a 1.5% increase.

Avoidance, Remedial or Reductive Measures

The roads will intercept natural overland and interflow that will have to be channelled into interceptor drains on the uphill side, and culverted to the downhill side to avoid erosion. It is recommended that silt traps be included at locations A,B,C and D, where the site drainage pipes connect to the existing streams, as shown in figure 20, overleaf. The traps could be constructed from natural stone, and should have a capacity of 2 m^3.


N
LEGEND
CONTOURS
WATERCOURSE
EXISTING ROADS
PROPOSED ROADS
WIND GENERATORS
CONTROL COMPOUND
MULLAGHMESHA
LOUGH AGOWER
COOMANORE LOUGH
SUBSTATION AND CONTROL BULDING
OVERHEAD POWER LINES
A
B
C
D
1
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GREEN POWER LIMITED,
RAILWAY VIEW,
MACROOM, CO. CORK.
SOUTH WESTERN FARM SERVICES
WIND FARM AT
MULLAGHMESHA, CO. CORK.
FIGURE 20: SILT TRAP LOCATIONS
8001
8001-1

Likely Impacts of the Development

Insignificant impact on runoff to streams.

Monitoring

Deemed not necessary.

Reinstatement

Maintenance of culverts and silt traps on an annual basis.

Forecasting Methods

Hydrological analysis using FSR Technique.

Difficulties in Compiling Specified Information

None.

Conclusions: Impact on Hydrology

Minimal 1.5% increase in runoff for a five year rain storm.

Roadways on site should not cause any erosion problems if properly drained.

AIR AND CLIMATE

The Receiving Environment

Without air quality monitoring, the current air quality is unknown. However, it is likely that the air quality at Mullaghmesha is excellent, since there are no pollutant sources in the vicinity. In Ireland, such sources generally include fossil-fuelled power production, heavy industry and transportation. None of these sources exist nearby (except for local traffic, which has a negligible effect on air quality at the site, being of a very low volume). Ongoing research, particularly that carried out at UCG, shows that the air quality on the West coast of Ireland is very pure, and there is no reason to expect that it is very different at Mullaghmesha.

Relevant Characteristics of this Proposal

Wind turbines, in contrast to more usual forms of power production, such as coal-, peat-, oil- or gas-fuelled power stations, emit no pollutants into the air.

"Wind energy is a clean source of renewable energy. This simple statement does little to convey its significance. Wind energy is at the forefront of what Worldwatch Institute's Chris Flavin calls the modern approach to battling pollution, an approach that turns away from "end of pipe" treatments and toward solutions that deal with the pollutants at their source. In some sectors, such as electricity generation, this means switching to zero-emission sources such as wind turbines.

The electricity generated by wind turbines offsets air pollution that otherwise would be generated by conventional power plants. Wind generation offsets the emission of nitrogen oxides (NO_x), sulphur oxides (SO_x), particulates, carbon monoxide and carbon dioxide (CO_2) that otherwise would be emitted to generate the same amount of electricity. This is wind energy's principal environmental attribute, its environmental *raison d'être.*"[25]

Potential Impacts of the Development

There will be no impact on local air quality. This contrasts to the impact that would be expected from a pollution-emitting form of electricity generation. Aside from local air quality, fossil fuel production releases carbon dioxide, which is a greenhouse gas, considered to be responsible for global warming.

Avoidance, Remedial or Reductive Measures

This does not apply, since the effects are beneficial.

Likely Impacts of the Development

There will be no impact on local air quality. Every unit of electricity produced by wind rather than traditional fossil fuel generation saves 800 g of carbon dioxide, 10 g of sulphur dioxide, and 3.4 g of nitrogen oxides.[26] That means 9504 kg of carbon dioxide, 119 kg sulphur dioxide, and 40 kg nitrogen oxides saved for every hour of peak production, over the lifetime of the plant. To put this in context, a 5 MW wind farm could save 10,500 – 16,100 tonnes of carbon dioxide per annum; 875,000 - 1341667 trees would be required to consume this each year (each tree consuming 12 kg CO_2 per annum).

Monitoring

This is not required, since the effect on air quality will be beneficial.

Reinstatement

Not applicable.

Forecasting Methods

Not required.

Difficulties in Compiling Specified Information

Not applicable.

Conclusions: Impact on Air and Climate

The proposed development at Mullaghmesha will replace pollution-emitting power generation. Globally, it would mean a reduction in Ireland's contribution to carbon dioxide production.

SHADOW FLICKER

The Receiving Environment

The Mullaghmesha wind farm site is a relatively level site on top of Mullaghmesha Mountain. Any houses nearby, to the West, South, or East could be of concern. There are no houses on the mountain itself. Only houses at the foot of the mountain could be affected.

Relevant Characteristics of this Proposal

The height of the wind turbines means that their shadows are likely to be projected over some distance. The characteristic movement of the turbine blades means that if the turbines lie in a direct line between the sun and a nearby house, a flickering shadow effect may occur, which could be considered a nuisance where the shadows are passing windows. The shadows are not considered a nuisance outdoors any more than shadows from trees moving in the wind.

Potential Impacts of the Development

As a worst case, a wind farm would lie directly between the sun and a house, with a steep incline rising up from the wind farm to the house. A shadow that might normally not reach the house would now be elongated by the hill. However, at Mullaghmesha the opposite occurs: the wind farm lies on top of a hill, so that any shadows falling downhill from it will be foreshortened. For the purposes of this analysis, it has been assumed that no beneficial foreshortening effects occur.

In the morning, the only houses possibly affected would be those to the west of the wind farm site. Due to the topography, houses to the west of the wind farm will be shielded from the effects of any shadows from the early morning sun by their already being in the shadow of Mullaghmesha mountain. Similarly, in the evening, the only houses possibly affected would be those to the east of the wind farm; again, due to the topography, these houses will already be in shadow.

This analysis assumed that the sun would be shining during all daylight hours, giving a worst case. The 30 year average of annual averages of mean daily duration of sunshine was 3.39 hours/day at Valentia Observatory[27], or 14% of the time. It was ascertained that the maximum shadow length that could fall is 730 m (see table 7 for sample calculations). This was assuming that, of the four turbine types shortlisted, the tallest was chosen, although there is little difference between them. No house lies within a 730 m radius of the site.

Avoidance, Remedial or Reductive Measures

These will not be necessary, since no receptors will be affected.

Likely Impacts of the Development

None.

Monitoring

Not applicable.

Reinstatement

Not applicable.

Forecasting Methods

Based on the height of the wind turbines, the latitude and longitude of the site; and the celestial latitude of the sun on each day of the year, the shadow lengths were calculated.

Difficulties in Compiling Specified Information

Not applicable.

Conclusions

Shadow flicker will not cause any problems at this site.

Latitude , longitude , your height feet, time zone.
Tabulate every days beginning .
Show Sun's declination (celestial latitude) and altitude above the horizon, too.
Daylight Saving Time

Convert your shadow length (in "feet" of 1/64 your height) into time of day, for given date, latitude 53.7N, longitude 9.3W, in GMT+0000 time zone. Leftmost shadow is at local noon, "dusk" at sunrise/set; 24-hour clock. Bold numbers on the date line are shadow lengths in "feet". [brackets] show the sun's declination (celestial latitude) on that date, and other numbers on its line are the sun's altitude above the horizon, in degrees.

[-22.9]	13	13.3	13.1	12.4	11.0	9.6	7.9	6.1	5.0	0	[22.9]	59	58.3	52.0	42.4	28.1	17.7	11.0	7.3	5.2	0
1/01	**268.77**	**270**	**276**	**290**	**330**	**380**	**460**	**600**	**730**	**dusk**	**7/03**	**38.20**	**39.6**	**50**	**70**	**120**	**200**	**330**	**500**	**700**	**dusk**
	12:40	12:26	12:07	11:44	11:10	10:46	10:24	10:01	9:49	9:00		12:40	12:00	10:43	9:27	7:48	6:37	5:48	5:21	5:04	4:20
	noon	12:54	13:13	13:36	14:10	14:34	14:56	15:19	15:31	16:20		noon	13:20	14:38	15:54	17:33	18:44	19:33	20:00	20:17	21:01
[-22.9]	13	13.4	13.1	12.4	11.0	9.6	7.9	6.1	5.0	0	[22.8]	59	58.2	52.0	42.4	28.1	17.7	11.0	7.3	5.2	0
1/02	**266.94**	**268**	**274**	**290**	**330**	**380**	**460**	**600**	**730**	**dusk**	**7/04**	**38.33**	**39.7**	**50**	**70**	**120**	**200**	**330**	**500**	**700**	**dusk**
	12:40	12:27	12:07	11:42	11:09	10:45	10:23	10:01	9:49	9:00		12:41	12:01	10:43	9:27	7:48	6:38	5:49	5:21	5:05	4:21
	noon	12:53	13:13	13:39	14:12	14:35	14:58	15:29	15:32	16:21		noon	13:20	14:38	15:54	17:33	18:44	19:32	20:00	20:16	21:00
[-22.7]	14	13.5	13.2	12.4	11.3	9.6	7.9	6.1	5.0	0	[22.7]	59	58.0	52.0	38.7	26.2	17.7	11.0	7.3	5.2	0
1/03	**264.99**	**266**	**272**	**290**	**320**	**380**	**460**	**600**	**730**	**dusk**	**7/05**	**38.47**	**40**	**50**	**80**	**130**	**200**	**330**	**500**	**700**	**dusk**
	12:41	12:28	12:07	11:40	11:14	10:44	10:22	10:00	9:48	9:00		12:41	11:59	10:44	9:01	7:36	6:38	5:50	5:22	5:06	4:22
	noon	12:53	13:14	13:42	14:07	14:37	14:59	15:21	15:33	16:22		noon	13:22	14:37	16:20	17:45	18:43	19:32	19:59	20:16	20:59
[-22.6]	14	13.6	13.3	12.4	11.3	9.6	7.9	6.1	5.0	0	[22.6]	59	58.0	52.0	38.7	26.2	17.7	11.0	7.3	5.2	0
1/04	**262.92**	**264**	**270**	**290**	**320**	**380**	**460**	**600**	**730**	**dusk**	**7/06**	**38.63**	**40**	**50**	**80**	**130**	**200**	**330**	**500**	**700**	**dusk**
	12:41	12:28	12:07	11:37	11:12	10:43	10:21	9:59	9:48	8:59		12:41	12:01	10:45	9:02	7:37	6:39	5:50	5:23	5:07	4:23
	noon	12:54	13:15	13:45	14:10	14:39	15:01	15:23	15:34	16:23		noon	13:20	14:36	16:20	17:45	19:43	19:31	19:59	20:15	20:59
[-22.5]	14	13.7	13.4	12.6	11.3	9.6	7.9	6.3	5.0	0	[22.5]	59	58.0	52.0	38.7	26.2	17.7	11.0	7.3	5.2	0
1/05	**260.74**	**262**	**268**	**286**	**320**	**380**	**460**	**580**	**730**	**dusk**	**7/07**	**38.79**	**40**	**50**	**80**	**130**	**200**	**330**	**500**	**700**	**dusk**
	12:41	12:27	12:07	11:39	11:11	10:42	10:20	10:01	9:47	8:59		12:41	12:04	10:46	9:02	7:37	6:39	5:51	5:23	5:07	4:24
	noon	12:56	13:15	13:44	14:12	14:41	15:03	15:22	15:36	16:24		noon	13:18	14:36	16:19	17:44	18:42	19:31	19:58	20:14	20:58
[-22.4]	14	13.9	13.5	12.9	11.3	9.8	7.9	6.3	5.0	0	[22.4]	59	57.8	52.0	38.7	26.2	17.7	11.0	7.3	5.2	0
1/06	**258.45**	**259**	**266**	**280**	**320**	**370**	**460**	**580**	**730**	**dusk**	**7/08**	**38.96**	**40.3**	**50**	**80**	**130**	**200**	**330**	**500**	**700**	**dusk**
	12:42	12:32	12:06	11:43	11:09	10:45	10:19	10:00	9:46	9:58		12:41	12:02	10:47	9:03	7:38	6:40	5:52	5:24	5:08	4:25
	noon	12:51	13:17	13:40	14:14	14:39	15:04	15:23	15:37	16:25		noon	13:20	14:35	16:19	17:44	18:42	19:30	19:58	20:14	20:57
[-22.3]	14	14.0	13.7	12.9	11.3	9.8	7.9	6.4	5.2	0	[22.3]	59	57.7	52.0	38.7	26.2	17.7	11.0	7.3	5.2	0
1/07	**256.06**	**257**	**263**	**280**	**320**	**370**	**460**	**570**	**700**	**dusk**	**7/09**	**39.14**	**40.5**	**50**	**80**	**130**	**200**	**330**	**500**	**700**	**dusk**
	12:42	12:29	12:08	11:40	11:07	10:43	10:18	10:00	9:47	8:58		12:41	12:02	10:48	9:04	7:39	6:41	5:53	5:25	5:09	4:26
	noon	12:55	13:16	13:44	14:17	14:41	15:06	15:24	15:37	16:26		noon	13:20	14:34	16:18	17:43	18:41	19:29	19:57	20:13	20:56
[-22.1]	14	14.1	13.8	12.9	11.7	9.8	7.9	6.4	5.2	0	[22.1]	58	57.5	52.0	38.7	26.2	17.7	11.0	7.3	5.2	0
1/08	**253.37**	**255**	**260**	**280**	**310**	**370**	**460**	**570**	**700**	**dusk**	**7/10**	**39.33**	**40.7**	**50**	**80**	**130**	**200**	**330**	**500**	**700**	**dusk**
	12:42	12:27	12:09	11:37	11:11	10:42	10:17	9:59	9:46	8:57		12:41	12:02	10:49	9:05	7:40	6:42	5:54	5:26	5:10	4:27
	noon	12:58	13:15	13:47	14:13	14:43	15:08	15:25	15:38	16:28		noon	13:21	14:33	16:18	17:43	18:41	19:29	19:56	20:12	20:56
[-22.0]	14	14.3	13.9	13.1	11.7	9.8	8.1	6.4	5.2	0	[22.0]	58	57.4	52.0	38.7	26.2	17.7	11.0	7.3	5.2	0
1/09	**251.00**	**252**	**259**	**276**	**310**	**370**	**450**	**570**	**700**	**dusk**	**7/11**	**39.54**	**41**	**50**	**80**	**130**	**200**	**330**	**500**	**700**	**dusk**
	12:43	12:29	12:06	11:39	11:09	10:40	10:18	9:58	9:46	8:56		12:41	12:00	10:51	9:05	7:40	6:42	5:54	5:27	5:11	4:28
	noon	12:56	13:20	13:47	14:16	14:45	15:08	15:27	15:40	16:29		noon	13:22	14:32	16:17	17:42	18:40	19:28	19:56	20:12	20:55
[-21.8]	14	14.4	14.0	13.1	11.7	9.8	8.1	6.4	5.2	0	[21.9]	58	57.4	52.0	38.7	26.2	17.7	11.0	7.3	5.2	0
1/10	**248.35**	**249**	**256**	**274**	**310**	**370**	**450**	**570**	**700**	**dusk**	**7/12**	**39.75**	**41**	**50**	**80**	**130**	**200**	**330**	**500**	**700**	**dusk**
	12:43	12:32	12:06	11:38	11:07	10:39	10:16	9:57	9:44	8:55		12:41	12:04	10:52	9:06	7:41	6:43	5:55	5:28	5:12	4:29
	noon	12:54	13:20	13:48	14:19	14:48	15:10	15:29	15:42	16:31		noon	13:19	14:31	16:16	17:42	18:39	19:27	19:55	20:11	20:54
[-21.7]	15	14.5	14.2	13.3	12.0	10.1	8.1	6.4	5.2	0	[21.7]	58	57.2	52.0	38.7	26.2	17.7	11.0	7.3	5.2	0
1/11	**245.62**	**247**	**253**	**270**	**300**	**360**	**450**	**570**	**700**	**dusk**	**7/13**	**39.97**	**41.3**	**50**	**80**	**130**	**200**	**330**	**500**	**700**	**dusk**
	12:43	12:27	12:07	11:39	11:12	10:41	10:15	9:56	9:43	8:55		12:41	12:03	10:53	9:07	7:42	6:44	5:56	5:29	5:13	4:30
	noon	12:59	13:20	13:48	14:15	14:46	15:12	15:31	15:43	16:32		noon	13:20	14:30	16:16	17:41	18:39	19:27	19:54	20:10	20:53
[-21.5]	15	14.7	14.4	13.3	12.0	10.1	8.1	6.4	5.2	0	[21.6]	58	57.0	52.0	38.7	26.2	17.7	11.0	7.3	5.2	0
1/12	**242.83**	**244**	**250**	**270**	**300**	**360**	**450**	**570**	**700**	**dusk**	**7/14**	**40.21**	**41.6**	**50**	**80**	**130**	**200**	**330**	**500**	**700**	**dusk**
	12:44	12:29	12:07	11:35	11:09	10:39	10:14	9:55	9:42	8:54		12:42	12:02	10:55	9:08	7:43	6:45	5:57	5:30	5:14	4:31
	noon	12:58	13:20	13:52	14:18	14:49	15:14	15:33	15:45	16:34		noon	13:21	14:28	16:15	17:40	18:38	19:26	19:53	20:09	20:52
[-21.4]	15	14.9	14.5	13.5	12.0	10.1	8.1	6.4	5.2	0	[21.4]	58	56.7	52.0	38.7	26.2	17.7	11.0	7.3	5.2	0
1/13	**239.97**	**241**	**248**	**266**	**300**	**360**	**450**	**570**	**700**	**dusk**	**7/15**	**40.45**	**42**	**50**	**80**	**130**	**200**	**330**	**500**	**700**	**dusk**
	12:44	12:30	12:05	11:36	11:07	10:37	10:12	9:53	9:41	8:53		12:42	12:00	10:56	9:09	7:44	6:46	5:58	5:31	5:15	4:33
	noon	12:58	13:23	13:52	14:21	14:51	15:16	15:35	15:47	16:35		noon	13:24	14:27	16:14	17:40	18:37	19:25	19:52	20:08	20:51
[-21.2]	15	15.1	14.6	13.8	12.0	10.1	8.1	6.4	5.2	0	[21.2]	58	56.7	52.0	38.7	26.2	17.7	11.0	7.3	5.2	0
1/14	**237.05**	**238**	**245**	**260**	**300**	**360**	**450**	**570**	**700**	**dusk**	**7/16**	**40.71**	**42**	**50**	**80**	**130**	**200**	**330**	**500**	**700**	**dusk**
	12:44	12:31	12:06	11:40	11:04	10:35	10:10	9:52	9:40	8:52		12:42	12:03	10:58	9:10	7:45	6:47	5:59	5:32	5:16	4:34
	noon	12:58	13:23	13:49	14:25	14:54	15:18	15:37	15:49	16:37		noon	13:20	14:26	16:13	17:39	18:36	19:24	19:51	20:07	20:50
[-21.0]	15	15.2	14.8	13.8	12.0	10.1	8.3	6.4	5.2	0	[21.1]	57	56.5	52.0	38.7	26.2	17.7	11.0	7.3	5.2	0
1/15	**234.09**	**235**	**242**	**260**	**300**	**360**	**440**	**570**	**700**	**dusk**	**7/17**	**40.98**	**42.3**	**50**	**80**	**130**	**200**	**330**	**500**	**700**	**dusk**
	12:45	12:31	12:06	11:36	11:02	10:33	10:11	9:50	9:38	8:51		12:42	12:03	11:00	9:11	7:46	6:48	6:00	5:33	5:18	4:35
	noon	12:58	13:24	13:53	14:28	14:56	15:18	15:39	15:51	16:39		noon	13:21	14:24	16:13	17:38	18:36	19:23	19:50	20:06	20:48
[-20.8]	15	15.4	14.9	13.8	12.0	10.4	8.3	6.4	5.2	0	[20.9]	57	56.4	50.9	38.7	26.2	17.7	11.0	7.3	5.2	0
1/16	**231.08**	**232**	**240**	**260**	**300**	**350**	**440**	**570**	**700**	**dusk**	**7/18**	**41.26**	**42.6**	**52**	**80**	**130**	**200**	**330**	**500**	**700**	**dusk**
	12:45	12:31	12:03	11:32	10:59	10:35	10:09	9:49	9:37	8:50		12:42	12:03	10:50	9:12	7:47	6:49	6:02	5:34	5:19	4:37
	noon	12:59	13:27	13:58	14:31	14:55	15:21	15:41	15:53	16:40		noon	13:21	14:34	16:12	17:37	18:35	19:22	19:49	20:05	20:47
[-20.6]	16	15.6	15.2	14.1	12.4	10.4	8.3	6.4	5.2	0	[20.7]	57	56.1	50.9	38.7	26.2	17.7	11.0	7.3	5.2	0
1/17	**228.04**	**229**	**236**	**255**	**290**	**350**	**440**	**570**	**700**	**dusk**	**7/19**	**41.55**	**43**	**52**	**80**	**130**	**200**	**330**	**500**	**700**	**dusk**
	12:45	12:31	12:05	11:34	11:03	10:33	10:08	9:48	9:36	8:49		12:42	12:01	10:52	9:13	7:48	6:50	6:03	5:36	5:20	4:38
	noon	13:00	13:26	13:57	14:28	14:58	15:23	15:43	15:55	16:42		noon	13:23	14:32	16:11	17:36	18:34	19:21	19:48	20:04	20:46
[-20.4]	16	15.8	15.4	14.4	12.4	10.4	8.3	6.5	5.2	0	[20.5]	57	56.1	50.4	38.7	26.2	17.7	11.0	7.3	5.2	0
1/18	**224.96**	**226**	**233**	**250**	**290**	**350**	**440**	**560**	**700**	**dusk**	**7/20**	**41.85**	**43**	**53**	**80**	**130**	**200**	**330**	**500**	**700**	**dusk**
	12:46	12:31	12:05	11:36	11:00	10:31	10:06	9:47	9:34	8:48		12:42	12:06	10:48	9:15	7:49	6:51	6:04	5:37	5:21	4:40
	noon	13:01	13:27	13:56	14:32	15:01	15:26	15:44	15:57	16:44		noon	13:18	14:36	16:10	17:35	18:33	19:20	19:47	20:03	20:45
[-20.2]	16	16.0	15.5	14.4	12.4	10.4	8.3	6.5	5.2	0	[20.3]	57	55.8	50.4	38.7	26.2	17.7	11.0	7.3	5.2	0
1/19	**221.85**	**223**	**230**	**250**	**290**	**350**	**440**	**560**	**700**	**dusk**	**7/21**	**42.16**	**43.5**	**53**	**80**	**130**	**200**	**330**	**500**	**700**	**dusk**
	12:46	12:30	12:05	11:31	10:57	10:28	10:04	9:46	9:33	8:46		12:42	12:03	10:50	9:16	7:50	6:52	6:05	5:38	5:23	4:41
	noon	13:02	13:28	14:01	14:35	15:04	15:28	15:47	15:59	16:46		noon	13:21	14:34	16:09	17:34	18:32	19:19	19:46	20:02	20:43
[-20.0]	16	16.2	15.7	14.6	12.9	10.7	8.3	6.5	5.2	0	[20.1]	56	55.5	50.4	38.7	26.2	17.7	11.0	7.3	5.2	0

TABLE 7: SAMPLE RESULTS OF SHADOW FLICKER CALCULATIONS

CONSTRUCTION IMPACTS

THE RECEIVING ENVIRONMENT

Besides the access roads, this is essentially a greenfield site, without services.

CHARACTERISTICS OF THE PROPOSAL

There are three main elements in this development. As described earlier, these are:

- **civil works:** including site roads and associated drainage works, foundations, cable trenches, and site compound, and modifications to the existing low grade road network.
- **erection of the turbines**
- **electrical works:** including the installation of the turbine, microprocessors and other turbine equipment; 640 V to 20 kV transformers; cabling; 20 kV to 38 kV transformer; ESB switch gear; etc.

Portacabins for site facilities will also be required for the duration of the construction period, including a site office, a canteen, and toilets.

POTENTIAL IMPACTS OF THE DEVELOPMENT

Construction Vehicle Movement

The movement of vehicles across the site during construction can cause damage to vegetation and to the underlying peat.

Excavation

The excavation of material to facilitate the laying of site roads can lead to difficulties in the re-establishment of vegetation. In addition, the deposition of excess material in spoil heaps can be unsightly.

Traffic

The imposition of construction traffic on minor rural roads can lead to significant changes in frequency of use. Some bends on these roads may not be suitable for some of the large vehicles that will be required for the transport of equipment to the site. The transport of mud or dust from the site on to local roads may also be of concern.

Noise

There may be noise from machinery, etc. that could affect local residents over the period of construction.

Temporary Works

Site offices, a canteen, and toilets will need to be provided for workers on the site.

Duration and Timing of Construction

The timing and duration of the construction will affect flora and fauna within the site. Springtime activity is likely to have the greatest impact in each of these cases. Naturally, the duration of construction will contribute to the magnitude of any effects.

AVOIDANCE, REMEDIAL OR REDUCTIVE MEASURES

Construction Vehicle Movement

The movement of construction vehicles across the site will not be permitted except in predefined areas necessary for construction. Once the site roads have been completed, vehicles will be required to use them at all times unless strictly necessary. Construction has been timed so that site roads will be structurally viable before other works are carried out.

Excavation

Where excavation is required, the overlying turf will be preserved, and re-laid on the excavated banks. Where embankments are required, they will be constructed from previously excavated material, wherever that material proves suitable structurally. Excavated material will also be used for the reinstatement of the site after construction, and for landscaping. No permanent spoil heaps will be formed.

Traffic

Traffic generated over the construction period will be temporary in nature; once the wind farm is in place, none of this traffic will contribute to the permanent traffic levels in the area.

However, during the period of construction, the transport of mud and dust from the site on to the surrounding network of minor roads will have to be addressed. It is proposed that the section of each site road on the approaches to the public road network be paved in order to remedy this problem.

Noise

It will not be possible to shield receptors from construction noise, but as may be seen from the section of this report that deals with noise, distance mitigates the effect of noise very effectively.

This timetable assumes a working day of 08:00 - 12:00 and 13:00 - 17:00, Monday to Saturday. These are reasonable work hours, during which any noise is likely to be made. In any case, noise will not be made during unsociable hours (23:00 - 07:00).

Temporary Works

These facilities will be in place for the duration of construction only. It is not considered that they will have serious environmental effects. They will be entirely removed from the site on completion of construction, and the location will be reinstated.

Duration and Timing of Construction

This project has been timetabled from July until October, in line with OPW recommendations[28]. In fact, it is likely that the project will be completed in September, but allowance has been made for any potential delays. Thus, the most critical period of Spring can be avoided. This will minimise the effects on flora and fauna. This is also as late in the year as it is likely to be possible to work, as otherwise, weather conditions would be likely to be too poor for construction. In addition, this is the driest period for construction, which will also assist in minimising environmental effects.

LIKELY IMPACTS OF THE DEVELOPMENT

Construction Vehicle Movement

It is likely that the movement of construction vehicles will have a temporary impact in limited areas. The restriction of the vehicles to certain areas will restrict possible damage correspondingly. The subsequent reinstatement of those areas means that there will be no long term damage.

Excavation

The careful removal and subsequent re-laying of the turf on these areas means that there will not be any damage to vegetation; this will also prevent any subsequent erosion in these areas.

Traffic

A typical number of trips on the access roads are 0 - 2 in winter, and up to about 10 in the spring time, when the busiest turf-cutting activities coincide with lambing. Generated traffic is likely to be as follows (all trips being return trips, all having their origin outside the site):

TABLE 8 TRAFFIC GENERATED BY CONSTRUCTION

Purpose of Trip	Origin of Trip	Distance of Trip	Maximum No. of Trips / Day	Over a Maximum No. of Days*
Delivery of Plant	local	not likely to be more than 15 km	7	4
Workers	local	not likely to be more than 15 km	25	94
Concrete Delivery	Drimoleague Dunmanway or Bantry	6.5 - 14 km, depending on supplier	20	18
Delivery of Reinforcement	Cork	80 km	1	11
Delivery of Building and Drainage Materials	local	not likely to be more than 15 km	1	5
Delivery of Towers	Undecided	Unknown to date	3	18
Delivery of Blades	Castletownbere or Cork	80 km	1	9
Delivery of Electrical Materials	Castletownbere or Cork	80 km	2	5
Cranes	Cork	80 km	2	1

*Not necessarily consecutive.

It is clear that although the traffic volume will have increased, and will be greatest at the time of the construction of foundations, the total traffic volume will still not be high. In addition, there are three access roads to the site. When distributed among the three roads, actual traffic increase will be less again. This traffic will last for the duration of the project only. However, some of this traffic will be heavier in nature than existing traffic, possibly requiring some road strengthening on the minor approach roads, as indicated in figure 3; heavy construction traffic will therefore take the route marked.

Also, some road realignment may be necessary at sharp bends on the route indicated for construction traffic. This will be possible within the existing boundaries of the site in most cases; in one other case, the landowner has agreed to necessary works. Details are shown in figure 3.

The paving of the approaches of the site roads to the public road network should alleviate any problems due to mud or dust being transported from the site.

Noise

It is likely that there will be some machinery noise from plant on site. This noise is likely to occur during normal weekday working hours, and will certainly not occur during unsociable hours. Distance will mitigate any noise effects at nearby residences to a very great extent, so that typical day-time farm noise should not be much exceeded.

Temporary Works

Negligible.

Duration and Timing of Construction

The construction work will have an impact on the flora and fauna of the site at any time of the year. However, it will be temporary, and the timing of construction has a significant effect on the extent of any impact. The nature of the work, and the exposed nature of the site mean that winter construction would be quite difficult. Thus, construction has been scheduled for as late in the year as possible, but before Winter, i.e., from July to October. The Office of Public Works *Guidelines for Windfarms, Windmills and Transmission Masts* recommends that construction avoided outside these months.[29] Thus, the most critical period of Spring can be avoided, minimising environmental effects. There is little danger that the construction timetable could not be adhered to, since a generous time-tabling was allowed for.

MONITORING

A monitoring programme can be agreed with Cork County Council for any aspect of the construction operations if required.

REINSTATEMENT

As discussed, reinstatement of the site after the completion of construction is a priority.

FORECASTING METHODS

Traffic predictions have been calculated on the basis of the plant, materials and staff required for the construction of the wind farm.

CONCLUSIONS: IMPACTS OF CONSTRUCTION

The environmental impacts of construction are temporary, but may constitute a temporary nuisance, so it is imperative that every effort be made to avoid or to minimise them. As recommended in the *European Best Practice Guidelines for Wind Energy Development*[30], the developers will appoint one member of staff with responsibility for site management, who will have responsibility for all aspects of the work. This will ensure that all contractors comply with the required environmental measures.

VISUAL IMPACT

In this study, the siting and design of a wind farm was carefully considered in respect of the scale and character of Mullaghmesha and the surrounding landscape. A detailed assessment was made on the perception of the development in terms of the overall character and individual elements comprising the landscape within a 5km radius of the proposed site and at numerous locations up to 12.2 km from the site.

Mullaghmesha is a medium scale exposed landscape, and has no landscape value designation attached to it at national or local level. It is not remote, nor could it be described as a wilderness

The afforested landscape in the vicinity, in subjective terms, is bland, monochromatic, uniform (in terms of variety), and very ordinary. Clearly, receptors within the forested areas will not be able to view the proposed development.

The valley landscapes to the north and to the south east of Mullaghmesha are simple, balanced, enclosed, and small scale. While the derelict castle in the valley setting at Castledonavan could be described as unusual the remaining valley landscape within the area surveyed though pleasantly interesting, could not be described as rare or unique. For most of the broad valley landscape to the north of the site, there is no visual impact in respect of the proposed development. Visual impact is confined to the western boundary of this zone where views of the development are largely intermittent.

In subjective terms, the rolling lowland within the area surveyed could be described as open, of medium scale, varied (in terms of diversity), and dominated by pasture land. While the landscape is interesting and pleasant, its well managed appearance makes it ordinary in the lexicon of Irish landscapes.

Particular attention was paid to the visual impact of the development in respect of the existing landform, skyline and land use. Turbine design elements considered included type, size, colour, spacing, number, array and operating characteristics. Good design practice was also followed to minimise the visual impact of ancillary development such as buildings, on-site service roads and power connections to the national grid.

This has meant that in no location are more than 10 of the turbines visible at any one time. The chosen layout, and the topography of the site, mean that only those turbines at the nearest edge of the site will be seen.

N 71

An imperceptible to slight unavoidable and transient visual impact will result for road users at a restricted number of distant locations on the N 71.

Dunmanway – Coolkellure – Castledonavan – Bantry Road

A slight, unavoidable, and transient visual impact will result for road users on restricted sections of the Dunmanway – Coolkellure – Castledonavan – Bantry Road. Due to the intervening landmass of Nowen Hill to the west, the development will not be visible from the scenic Coolkellure area, or from the nearby designated amenity area overlooking Cullenagh Lake.

Drimoleague

A slight visual impact and some degree of visual confusion will result for some residents of Drimoleague under conditions of good to excellent visibility.

It should be noted that the 30 year average of annual averages of mean daily duration of sunshine was 3.39 hours/day at Valentia Observatory[31], or 14% of the time. Thus it is likely that such conditions of good to excellent visibility are unlikely to occur for more than 14% of the time. Even then, because the site lies to the north of Drimoleague, the sun will never shine from behind the wind farm, relative to Drimoleague. When the sun is shining directly on the turbines, from the direction of the viewer, their pale colour and matt texture allow them to effectively fade into the background, and become less visible.

Castledonavan

A slight to moderate visual impact will result for valley residents and visitors in respect of the proposed development. A contrast of association will be experienced by the visual juxtaposition of old and new. The proposed turbine layout is the best compromise between the demand for wind farm technical and economical efficiency and preservation of the local scenic and cultural heritage.

Rolling Lowland

A slight visual impact will result for receptors in rolling lowlands within a 5 km radius of the proposed site. Views from a southerly and south westerly perspective will be obscured or restricted by intervening hilly topography and extensive coniferous plantations. At distances of less than 2 km from the development the visual impact will range from slight to moderate.

Residential Properties Near the Site

A moderate to significant visual impact will result for some residents living within 1 km of the proposed development. However, this impact will be restricted to views of a small number of turbines within a narrow arc of vision. In addition, several of these residences are surrounded by shelter belts of tall trees, meaning that they are unlikely to have a view of the wind farm from their homes.

With particular regard to local residents, the following is an important point:

"In general,...surveys on both sides of the Atlantic reveal that those who favour renewable energy are more likely to find wind's impact on the community acceptable, those who are neutral will accept wind turbines on the landscape if they know they are beneficial, and those who object to wind development on philosophical grounds will find it unacceptable regardless of mitigation measures."[32]

An information campaign was conducted in the local area at the Mullaghmesha site, involving a personal visit to each of the local residences, and the distribution of information packs, has established that local opinion is favourable towards the proposed project.

Of 59 residences visited, 54 had no objection to the proposed development, 4 had further queries, and 1 could not be contacted. In particular, of the 8 occupied residences within 1 km of the site – those who would be most affected – 7 are very positive in their support for the development, and 1 is neutral.

Such strong support is all the more remarkable when it is generally considered that it as at the current stage of the development – the proposal/planning stage - that support would often be at its lowest. For example, throughout Europe, it has been found that wind energy is very much approved of in principle, until a specific project is proposed. Such proposals often elicit a negative reaction that dampens public support, but approval generally returns to pre-proposal levels of support, once the project has been installed, and communities have had time to adjust. A diagram of percentage acceptance in the community can often appear as follows:[33]

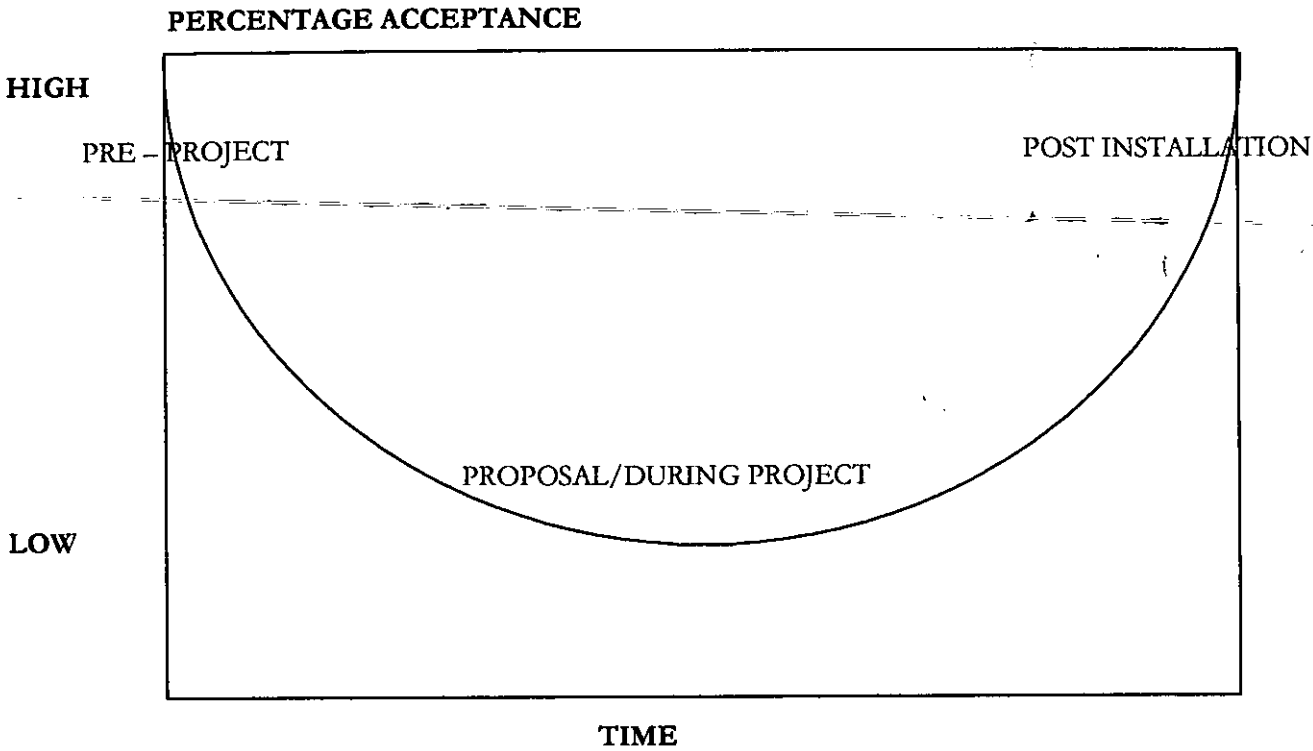

FIGURE 21: ACCEPTANCE OF WIND ENERGY

That local support is so high at a time when it could be expected to be at a lower level, gives a very positive indication of long term support.

Mitigation

By international standards, this is a small development, of a size more suited to Irish landscapes. Turbine make, colour and finish, and turbine layout were all examined with a view to reducing visual effect, and the guidelines established by various regulatory bodies were followed in order to assist in attaining this goal. In particular, the *Planning Guidelines for Wind Energy*, by the Irish Planning Institute, were found to be the most detailed, and most relevant to Irish developments.

In terms of landform, the overall visibility of the turbine array was significantly reduced by locating the wind farm on relatively flat topography situated just below the summit of Mullaghmesha, so that no more than ten of the turbines are ever visible at any one time from any viewing point.

Ancillary developments were given equally careful consideration:

- the compound containing the control house and ESB primary gear will be situated in a dip in the landscape to the south of the site, so that its visibility will be very restricted; the control house will be faced in local stone; in addition, the compound will be screened by suitable hedging.

- Cork County Council has identified the construction of new roads as being of concern. Three roads to the site already exist, only one of which would require minor modification. If even, this were unacceptable, the other two existing roads will suffice for access. Where tracks are required between turbines, these will be constructed in farm-track style, similar to those already existing, and they will be constructed along contours as much as possible, in order to reduce any visual impact.

- the site is very near the ESB 38 kV line, so that the grid connection will require a connection length of as little as 1.1 km.

On the whole, the landscape has been much affected by human influence, and this is evident by the presence of coniferous plantations, turf – cutting sites, fenced in rough grazing areas, telecommunication masts, and a number of access tracks to the site. The introduction of a further functioning element will not unduly detract from the overall value of the existing landscape.

WIND FARMS ARE NORMALLY LOCATED ON EXPOSED LANDSCAPES DUE TO THEIR TECHNICAL REQUIREMENTS FOR WIND SPEED AND WIND CONSISTENCY. WHILE THE VISUAL IMPACT OF WINDFARMS CANNOT BE ELIMINATED, GOOD DESIGN PRACTICE WILL AMELIORATE ANY ADVERSE VISUAL IMPACT TO AN ACCEPTABLE DEGREE FOR MOST RECEPTORS LIVING WITHIN THE VISUAL ENVELOPE OF THE MULLAGHMESHA DEVELOPMENT. HOWEVER FOR RESIDENTS LIVING WITHIN 1 KM FROM ANY TURBINE IN THE OVERALL ARRAY, A MODERATE TO SIGNIFICANT ADVERSE VISUAL IMPACT WILL RESULT.

NOISE

There are two distinct types of noise sources within a wind turbine:

- the mechanical noise produced by the gearbox, generator, and other parts of the drive train. This noise is contained within the nacelle by sound insulation and isolation materials.

- the aerodynamic noise produced by the passage of the blades through the air. This noise is generally unobtrusive, and broad band in nature,

The predicted noise levels from turbines is normally compared with the background noise existing in the area.

From testing undertaken between the 9th and the 11th December 1997, it was determined that the day-time and night-time L_{Aeq} values for periods without high wind were each determined at 42 dBA, there being little difference between the day and night noise levels. The night-time background noise level (L_{A90}) was determined as 33 dBA.

The maximum predicted noise levels with all of the proposed wind turbines in operation are shown for each of the nearest residences in the table below. It can be seen that these levels are almost identical to the measured existing night-time noise levels (L_{Aeq}) also shown on that table. Also the predicted background noise level (L_{A90}) is less than 40 dBA at all these residences. The calculation of these noise levels is based on conservative assumptions such as ignoring the shielding effects of intervening ridges, rock outcrops, etc.; it is likely that the noise impact would be even lower than estimated.

TABLE 9: EXISTING AND PREDICTED NOISE LEVELS AT NEAREST RESIDENCES

Residence	Turbine noise level (L_{Aeq})	Existing night level (L_{aeq})	Predicted L_{Aeq} level	Predicted L_{A90} level
D. O'Leary	32	42	42	36
T.J. O'Leary	38	42	43	39
H.& C. Wehrli	32	42	42	36

The noise levels in the vicinity of any residences are very low and turbine noise would not normally be audible.

ELECTRO-MAGNETIC EFFECTS

The types of electro-magnetic signals with which the turbines have the potential to interfere are terrestrial microwave links, and television broadcasts. This may be of the form of signal scattering, possibly producing "ghost" signals; alternatively, the turbines might obstruct signals.

Point to Multipoint Microwave TV

MMDS transmission by Irish Communications from Nowen Hill is routed around rather than across Mullaghmesha, because of blocking of the signal due to the topography; thus the proposed development is not likely to interfere with these transmissions.

Point-to-Point Microwave Links

Neither RTE, Irish Communications, the ESB, Eircell, nor Esat Digifone operate point to point microwave networks across Mullaghmesha. No other users of point to point microwave networks were found in the vicinity. Concern regarding interference to point to point microwave links can be eliminated due to the absence of such links intersecting Mullaghmesha.

Terrestrial TV

It is not considered that the proposed development will have any significant negative effect on the quality of RTE TV reception, except, possibly, in the immediate area of the development.

Other Transmitters

South Coast Community TV is operating a UHF "deflector" TV transmitter at the site of the proposed development. It is receiving a signal from Carrigaline, and re-transmitting in an arc from Glengarriff to Drimoleague and Skibbereen. The legal position of this type of transmission has not been finalised at this time, so it is not possible to predict future developments. However, it is reasonably likely that signals transmitted to and from this mast would be subject to interference.

Mitigating Measures

The most likely cause of interference is that which will degrade the UHF TV signals that are currently being broadcast from an area within the proposed development. Once further information on these transmissions become available, it will be possible to remedy any problems. It is expected that the houses in the immediate vicinity will require remedial measures, but these are effective and relatively inexpensive.

Only in rare circumstances do wind farms give rise to problems with electro-magnetic signals, however, experience has shown that when this occurs it is of a predictable nature and can be generally alleviated by a technical solution.

HEALTH AND SAFETY

Extensive operational experience has shown that the wind turbine safety record is exceptionally high, probably having a better safety record than many other forms of electricity production. Extensive testing and approval records are available from turbine manufacturers. No member of the public has ever been injured by a wind turbine.

Some degree of botanical monitoring would be desirable, particularly in the area of re-instatement of the road margins, so that in the event of excess erosion further remedial measures could be adopted.

FLORA

The excavation of roads will result in the removal of a relatively small amount of the blanket bog habitat present. However, provided the area between the two loughs is avoided, botanically the most interesting area will be preserved.

Given that the general site is dominated by one main habitat type i.e. upland blanket bog in various states of wetness, the construction of the proposed roadways through it will not cause serious fragmentation of the remaining portion or lead to its non-viability. There is likely to be some local drying adjacent to roadways, especially where these coincide with deeper peat, resulting in a change in species composition to a more dry-heath community with perhaps a somewhat reduced range of species. The confined nature of the latter however, will not detract from the overall value of the site.

Given that the site was assessed in November there is the possibility that some rarer species might have been overlooked and this is why in tables 2 & 3 a list of the more important species possible or likely to be present at other seasons is presented. This list doesn't, however, contain any very rare species, and this combined with the absence of botanically scare micro-habitats would indicate that the risk of the development endangering a rare plant species is considered remote.

FAUNA: BIRDS

Taking into account the location and nature of the proposed Mullaghmesha development, experience at wind-farm developments in other countries, available published information on bird populations in the area, and the site visits described above, there is no strong evidence to indicate that this development will have other than a minimal impact on birds. The most significant potential impact would appear to involve disturbance of breeding attempts of, or collision mortality of, a small number of scarce, upland-nesting bird species, most notably Hen Harrier. Given this possibility, and the possibility of avian collision during nocturnal migration, consideration will be given to *avoidance, remedial or reductive measures*, and to the need for ongoing *monitoring*, as noted earlier.

FAUNA: MAMMALS (WITH OBSERVATIONS ON OTHER FAUNA)

The relatively high altitude of the site (c 305-494m), high exposure and low diversity of suitable habitats on the site would significantly limit the density of mammals and their level of utilisation of the site. Accordingly, the site can be generally described as of low importance to mammals.

Given the low level of site utilisation by mammals in general, potential impacts are also likely to be minor and are likely to be insignificant. The only exception to this is in the case of otters, which might abandon the two lakes on the site if access to them were blocked by road construction over the stream, which exits from Coomanore Lough.

Road construction might also lead to siltation of any streams which may be traversed by roads e.g., the outlet stream from Coomanore Lough. In each case this siltation would reduce the diversity of macroinvertebrate fauna present and possibly reduce the level of utilisation of the streams by fish.Disturbance during the construction phase may force otters to temporarily abandon the site.

Any road crossings of streams should be carefully executed so as to reduce the possibility of erosion of the banks or streambed. A small bridge with ledges to allow for the passage of otters should be built if necessary. Willow should be planted to form a shelter-belt on the banks of the stream in the vicinity of any bridge; this will ensure continued unimpeded access by otters to the lakes.

The overall impact development on mammals will be low and cannot be considered significant. The construction of the roadways on site is unlikely to interfere significantly with mammal density or utilisation of the area. The disturbance effect of the construction phase may force otters to temporarily abandon usage of the lake area in the short term. The species will however habituate in the medium term and provided there is no damage to the flow regime to the lakes, will continue to utilise the freshwater habitats on site.

ARCHAEOLOGY

The impact on the Cultural Heritage of Mullaghmesha, from the ground disturbance works associated with the excavations for the proposed roadways, cable trenches and wind turbine transformer sites for the Wind Farm, must be considered in two ways. The proposed development works can have an impact on the known archaeology and the unknown archaeology of the area.

In the case of the known archaeology there are three groups of hut sites located adjacent to the transformer sites W5 and W6. The ground disturbance works associated with the excavation of the roadway or the cable trench in this vicinity may have a major impact on the hut sites. The original extent of the hut sites can not be gauged from a surface examination.

In any area there exists the potential for buried archaeological sites, i.e., sites with no visible remains above ground. The presence of the groups of hut sites within the proposed area of development coupled with the existence of archaeological sites to the south-west and east of the area of development, at similar altitudes, may serve as an indication of the presence of other archaeological sites within the vicinity. The proposed excavation works could have an impact on unknown archaeological sites which may be located within or beneath the blanket bog.

The impact of the proposed development on the sites discussed would be negated if no development works are permitted to take place within 20m of the hut sites. The sites would need to be fenced off in advance of commencement of any development works. If a zone of protection was established in advance of development work then the impact of the proposed development on the Cultural Heritage of the area would be minimal. If a zone of protection was not afforded to the recorded sites then it would be necessary to record by excavation the sites in advance of the proposed development.

Air and Climate

There will be no impact on local air quality. This contrasts to the impact that would be expected from a pollution-emitting form of electricity generation. Aside from local air quality, fossil fuel production releases carbon dioxide, which is a greenhouse gas, considered to be responsible for global warming.

There will be no impact on local air quality. Every unit of electricity produced by wind rather than traditional fossil fuel generation saves 800 g of carbon dioxide, 10 g of sulphur dioxide, and 3.4 g of nitrogen oxides.[34] That means 9504 kg of carbon dioxide, 119 kg sulphur dioxide, and 40 kg nitrogen oxides saved for every hour of peak production, over the lifetime of the plant. To put this in context, a 5 MW wind farm could save 10,500 – 16,100 tonnes of carbon dioxide per annum; 875,000 - 1341667 trees would be required to consume this each year (each tree consuming 12 kg CO_2 per annum).

The proposed development at Mullaghmesha will replace pollution-emitting power generation. Globally, it would mean a reduction in Ireland's contribution to carbon dioxide production.

Shadow Flicker

As a worst case, a wind farm would lie directly between the sun and a house, with a steep incline rising up from the wind farm to the house. A shadow that might normally not reach the house would now be elongated by the hill. However, at Mullaghmesha the opposite occurs: the wind farm lies on top of a hill, so that any shadows falling downhill from it will be foreshortened. For the purposes of this analysis, it has been assumed that no beneficial foreshortening effects occur.

In the morning, the only houses possibly affected would be those to the west of the wind farm site. Due to the topography, houses to the west of the wind farm will be shielded from the effects of any shadows from the early morning sun by their already being in the shadow of Mullaghmesha mountain. Similarly, in the evening, the only houses possibly affected would be those to the east of the wind farm; again, due to the topography, these houses will already be in shadow.

This analysis assumed that the sun would be shining during all daylight hours, giving a worst case. The 30 year average of annual averages of mean daily duration of sunshine was 3.39 hours/day at Valentia Observatory[35], or 14% of the time. Based on the height of the wind turbines, the latitude and longitude of the site; and the celestial latitude of the sun on each day of the year, the shadow lengths were calculated. It was ascertained that the maximum shadow length that could fall is 730m. This was assuming that, of the four turbine types shortlisted, the tallest was chosen, although there is little difference between them. No house lies within a 730m radius of the site.

Shadow flicker will not cause any problems at this site.

CONSTRUCTION IMPACTS

Construction Vehicle Movement

The movement of vehicles across the site during construction can cause damage to vegetation and to the underlying peat. It is likely that this will have a temporary impact in limited areas.

The movement of construction vehicles across the site will not be permitted except in predefined areas necessary for construction. Once the site roads have been completed, vehicles will be required to use them at all times unless strictly necessary. Construction has been timed so that site roads will be structurally viable before other works are carried out.

The restriction of the vehicles to certain areas will restrict possible damage correspondingly. The subsequent reinstatement of those areas means that there will be no long term damage.

Excavation

The excavation of material to facilitate the laying of site roads can lead to difficulties in the re-establishment of vegetation. In addition, the deposition of excess material in spoil heaps can be unsightly.

Where excavation is required, the overlying turf will be preserved, and re-laid on the excavated banks. Where embankments are required, they will be constructed from previously excavated material, wherever that material proves suitable structurally. Excavated material will also be used for the reinstatement of the site after construction, and for landscaping. No permanent spoil heaps will be formed.

The careful removal and subsequent re-laying of the turf on these areas means that there will not be any damage to vegetation; this will also prevent any subsequent erosion in these areas.

Traffic

Traffic generated over the construction period will be temporary in nature; once the wind farm is in place, none of this traffic will contribute to the permanent traffic levels in the area. However, during the period of construction, the transport of mud and dust from the site on to the surrounding network of minor roads will have to be addressed. The paving of the approaches of the site roads to the public road network should alleviate any problems due to mud or dust being transported from the site.

It is clear that although the traffic volume will have increased, and will be greatest at the time of the construction of foundations, the total traffic volume will still not be high. In addition, there are three access roads to the site. When distributed among the three roads, actual traffic increase will be less again. This traffic will last for the duration of the project only. However, some of this traffic will be heavier in nature than existing traffic, possibly requiring some road strengthening on the minor approach roads.

Noise

There may be noise from machinery, etc. that could affect local residents over the period of construction. It will not be possible to shield receptors from construction noise, but as may be seen from the section of this report that deals with noise, distance mitigates the effect of noise very effectively, so that typical day-time farm noise should not be much exceeded. In addition, the construction timetable assumes a working day of 08:00 - 12:00 and 13:00 - 17:00, Monday to Saturday. These are reasonable work hours, during which any noise is likely to be made. In any case, noise will not be made during unsociable hours (23:00 - 07:00).

Temporary Works

Site offices, a canteen, and toilets will need to be provided for workers on the site. These facilities will be in place for the duration of construction only. It is not considered that they will have serious environmental effects. They will be entirely removed from the site on completion of construction, and the location will be reinstated.

Duration and Timing of Construction

The construction work will have an impact on the flora and fauna of the site at any time of the year. However, it will be temporary, and the timing of construction has a significant effect on the extent of any impact. Springtime activity is likely to have the greatest impact in each of these cases. Naturally, the duration of construction will contribute to the magnitude of any effects.

This project has been timetabled from July until October, in line with OPW recommendations[36]. In fact, it is likely that the project will be completed in September, but allowance has been made for any potential delays. Thus, the most critical period of Spring, particularly May and June, can be avoided. This will minimise the effects on flora and fauna. This is also as late in the year as it is likely to be possible to work, as otherwise, weather conditions would be likely to be too poor for construction. The nature of the work, and the exposed nature of the site mean that winter construction would be quite difficult. In addition, the schedule is for the driest period for construction, which will also assist in minimising environmental effects.

The environmental impacts of construction are temporary, but may constitute a temporary nuisance, so it is imperative that every effort be made to avoid or to minimise them. As recommended in the *European Best Practice Guidelines for Wind Energy Development*[37], the developers will appoint one member of staff with responsibility for site management, who will have responsibility for all aspects of the work. This will ensure that all contractors comply with the required environmental measures.

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[37] European Wind Energy Association; *European Best Practice Guidelines for Wind Energy Development.*

Comhairle Chontae Chorcaí

EOIN BRANGAN,
ROOM 24c,
CUSTOM HOUSE,
DUBLIN 1

F15750

Cork County Council
County Hall
Cork
Telephone: 021-276891
Fax: 021-276321

1008 372

2 October 1998

A Chara,

Planning Register No. W/98/1166

The Council have by Order dated: 01/10/98 decided to REFUSE PERMISSION as per schedule attached.

TO : GREEN POWER LTD

OF : c/o South Western Services Co-Op Soc. Ltd., Shinagh House, BANDON

FOR : Construction of a 12 MW Windfarm to incl. 20 no. wind turbines, associated control building/compound & internal site access tracks

AT : COOMANORE SOUTH,GLANACLOGHA, MULLAGHMESHA, DRIMOLEAGUE

Mise, le meas,

OIFIGEACH FOIRNE.
PLANNING DEPARTMENT

Gaeilge agat?... Labhair í

SCHEDULE

:ference No. in Planning Register: 98/1166

Reason

(1)
Site is located on the crest of a mountain in an open unspoilt scenic mountainous landscape which is incapable of absorbing the size and scale of the development proposed. It is considered that these areas should be kept free from development. The proposed development would, therefore, be contrary to the proper planning and development of the area.

(2)
Proposed development would be skyline and unduly obtrusive when viewed from adjacent Scenic Route A86. The proposed development would, therefore , be out of character with and seriously injure the amenities of the area and be contrary to the proper planning and development of the area.

(3)
Proposed development, in conjunction with other proposed wind farm projects, would result in an excessive density of wind farms in a limited area and would therefore be contrary to the proper planning and development of the area.

Comhairle Chontae Chorcaí

EOIN BRANGAN,
ROOM 24c,
CUSTOM HOUSE,
DUBLIN 1

Cork County Council
County Hall
Cork
Telephone : 021- 276891
Fax : 021-276321

31 March 1998

PLANNING REGISTRATION NO.: W/98/1166

EIS750

APPLICANT : GREEN POWER LTD

DEVELOPMENT : Construction of a 12 MW Windfarm to incl. 20 no. wind turbines, associated control building/compound & internal site access tracks

LOCATION : COOMANORE SOUTH,GLANACLOGHA, MULLAGHMESHA, DRIMOLEAGUE

A Chara,

An application for PERMISSION was received for the above proposal on 27/03/98.

I enclose for your information copy document(s).

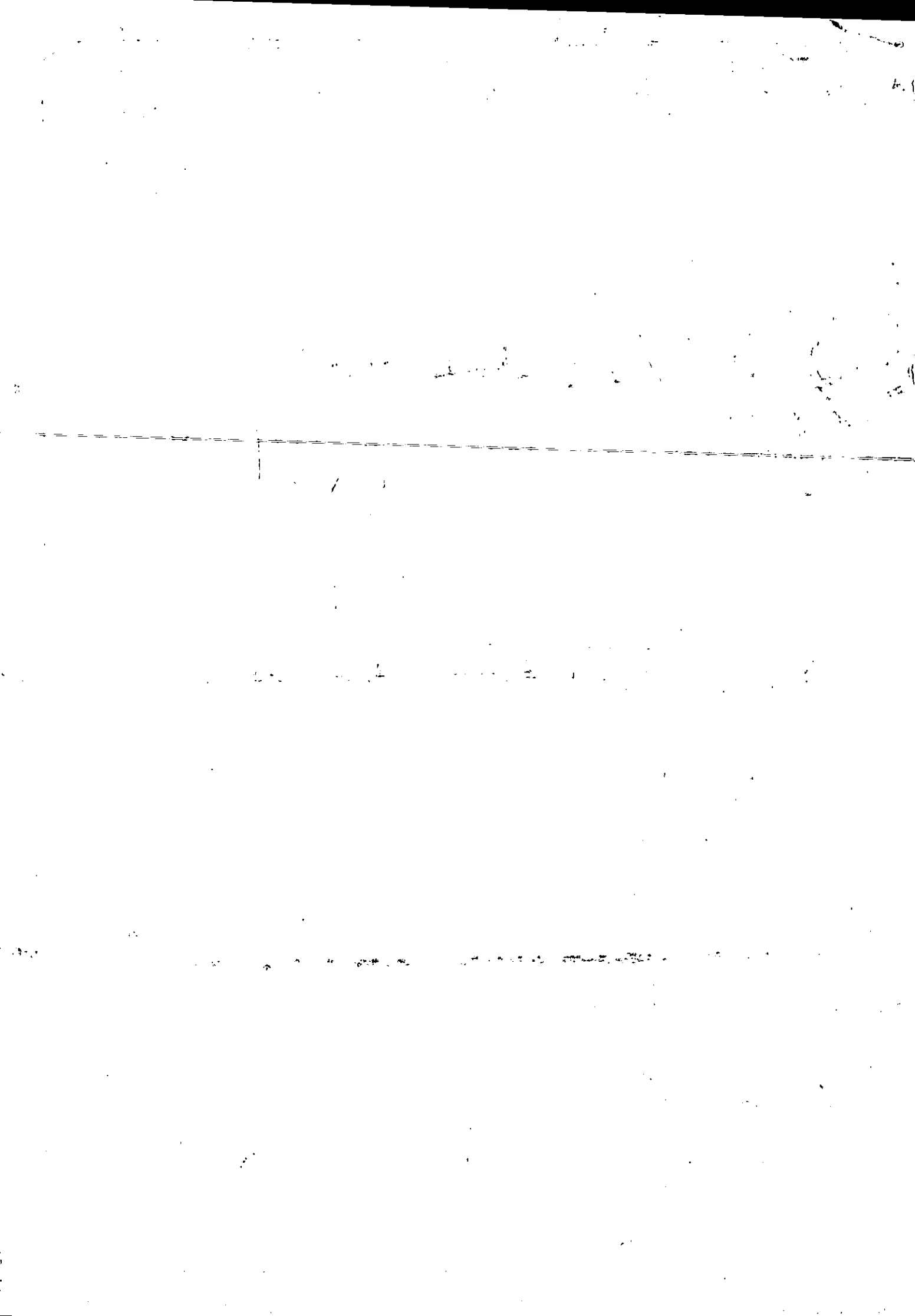
This application involves an Environmental Impact Statement, copy of which will be forwarded to you in due course.

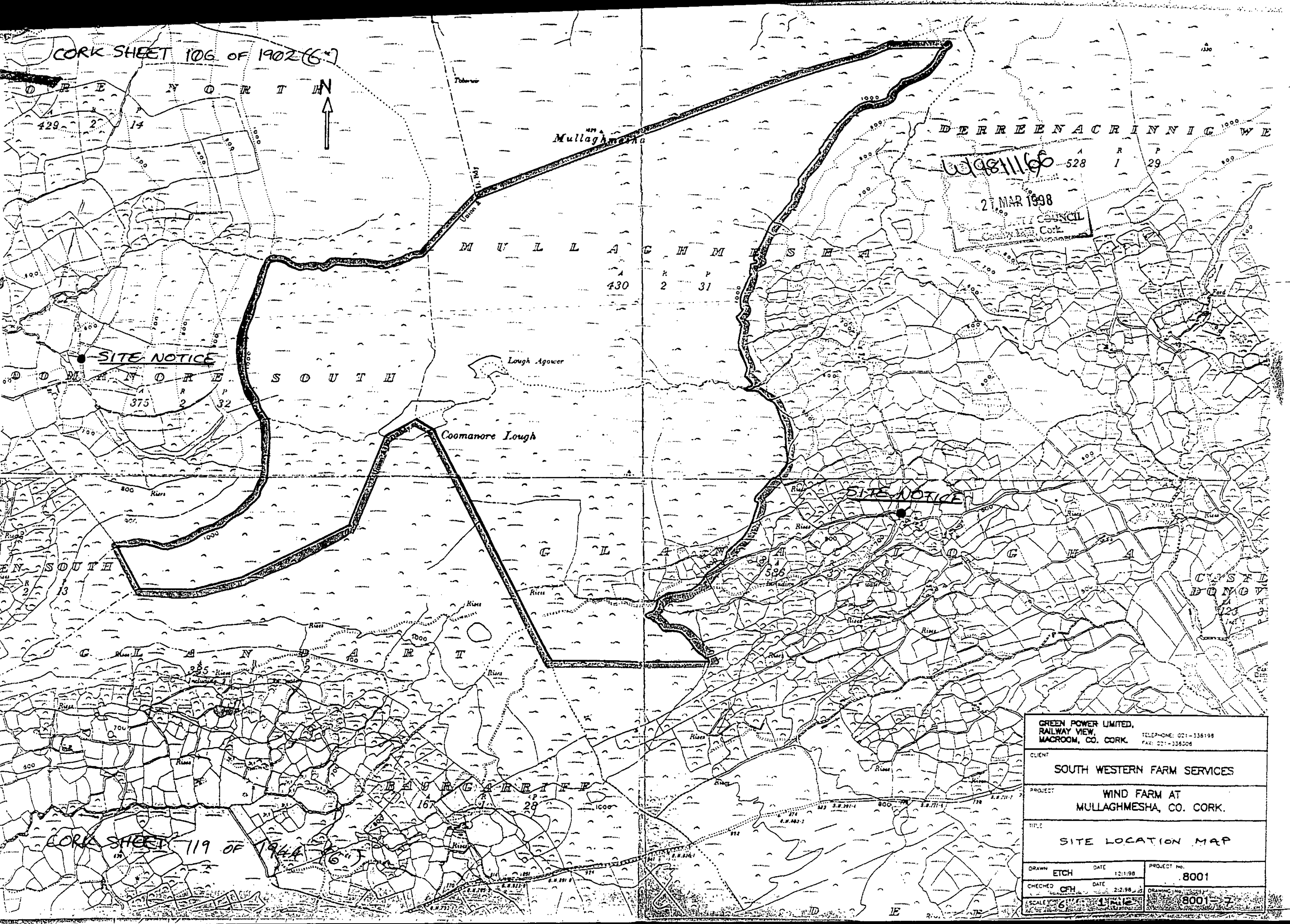
The development comprises or is for the purposes of an activity in relation to which a licence under Part IV of the Environmental Protection Agency Act, 1992 is required.

Mise, le meas,

OIFIGEACH FOIRNE
PLANNING DEPARTMENT

Gaeilge agat ? .....Labhair í

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GREEN POWER LIMITED,
RAILWAY VIEW,
MACROOM, CO. CORK.
CLIENT
SOUTH WESTERN FARM SERVICES
PROJECT
WIND FARM AT
MULLAGHMESHA, CO. CORK.
TITLE
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DATE 12:1:98
PROJECT No.
8001
CHECKED CFH
DATE 2:2:98
SCALE 6" : 1 Mile
DRAWING No. 8001-7

Comhairle Chontae Chorcaí

EOIN BRANGAN,
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IE IS 750

Cork County Council
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1008

11 November 1998

RE: PLANNING REGISTRATION NO. : W/98/1166

APPLICANT : GREEN POWER LTD

DEVELOPMENT : Construction of a 12 MW Windfarm to incl. 20 no. wind turbines, associated control building/compound & internal site access tracks

AT : COOMANORE SOUTH,GLANACLOGHA, MULLACHMESHA, DRIMOLEAGUE

Dear Sir/Madam,

I refer to previous correspondence regarding the above.

The Planning Authority has been notified by An Bord Pleanala that an appeal has been lodged against it's decision to REFUSE PERMISSION in this case.

You may, if you wish, make submissions or observations in writing to the Board in relation to an appeal subject to the payment of a fee of £36.00.

Any such submission or observation must be made within the period of one month beginning on the day of receipt of the appeal by the Board or, where there is more than one appeal, on the day on which the Board last receives an appeal.

In a case where an Environmental Impact Statement has been submitted, any such submission or observation must be made within the period of one month beginning on the day of publication by An Bord Pleanala of notice of the appeal.

Any further correspondence should be addressed to An Bord Pleanala, Floor 3, Block 7, Irish Life Centre, Lower Abbey Street, Dublin 1, quoting reference number PL04.108995.

Yours faithfully,

M. Allison
STAFF OFFICER,
PLANNING DEPARTMENT.

Gaeilge agat?... Labhair í