REFERENCE DOCUMENTS for PROPOSED LARGER TURBINES AND MET MASTS AT UPPERCHURCH WINDFARM for EIAR 2021 and AA 2021

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Upperchurch Windfarm (LA ref. 13/510003, ABP ref. PL 22.243040)

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UPPERCHURCH WINDFARM
ENVIRONMENTAL IMPACT STATEMENT

SUBMITTED BY ECOPOWER DEVELOPMENTS LIMITED
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AS PART OF A PLANNING APPLICATION
TO NORTH TIPPERARY COUNTY COUNCIL

REFERENCE DOCUMENTS

Upperchurch Windfarm Enviromental Impact Statement

1. Introduction

1.1. WIND ENERGY

Wind energy is harnessed using turbines that consist of an electrical generator driven by 3 aerodynamic blades, which are turned by the force of the wind. The generator is housed in a sound proofed box called a nacelle. This assembly of generator and blades is placed on top of a tower which is 60-126m high. The blades, that drive the generator, are up to 60m long. These large turbines, which are in the MW-class (above 1MW) now represent a share of more than 95 per cent of the turbine market in Europe.

Modern large turbines rotate at slower speeds of between 9-19rpm which compares favourably to earlier models which rotated at 30 rpm. They produce about 1.3 - 5MW of electricity per hour in a strong breeze. The turbines begin to operate at wind speeds of 3 meters/sec (6mph), produce full power at 13m/s (26mph) and shut down in storm conditions of 25m/s (56mph). The turbine then restarts automatically when the storm abates and windspeeds drop below 20m/s for more than a 10-minute period.

The turbines are monitored by remote computer link and can be stopped, by computer, at any time if necessary. Modern wind turbine technology development began in Denmark in the 1970's and 80's and has now reached a very high level of efficiency and reliability. Typically, a modern wind turbine will operate at over 97% availability and is designed to operate for more than 120,000 hours. By comparison, a car engine has a design lifetime of 4,000 to 6,000 hours.

1.2. WIND POWER AND CONVENTIONAL POWER

Transportation and conventional electricity generation cause the emission of greenhouse gasses which contribute substantially to global climate change which is the most serious environmental threat facing the planet.

It is estimated that worldwide energy demand will double in the next 25 years and supplying this demand by conventional generation plant will release ever greater volumes of carbon dioxide (CO_2) and other damaging gaseous compounds such as oxides of nitrogen (NO_x), and sulphur (SO_x) into the atmosphere. In addition to the threat of climate change from global warming, fossil fuels will become exhausted unless energy production from the use of viable sustainable sources is substituted.

One of the principal market drivers for wind energy is the fact that it is a clean, renewable and sustainable means of electricity generation. However, beyond its advantages in terms of combating climate change and addressing the need for increased electricity generating capacity, wind energy can be a major contributor to economic welfare and one of the solutions to the current economic turmoil. Wind power has the potential to satisfy the increasing electricity demand in a sustainable manner; it is also a significant and vital stimulus to new green economic activity. Greater energy independence, lower energy costs, hedging against rising fuel prices, improved competitiveness and major employment opportunities are among the attractions that the technology has to offer Ireland.

European wind technology is the leader in renewable energy technologies. It has evolved from an industry making small, simple turbines into a technology, which can compete with the well-established forms of power generation. The cost of wind generated electricity on an elevated site is now comparable with the most efficient fossil fuel generating plant.

Renewable power installations accounted for 71.3% of new electricity generation capacity during 2011 in the EU. EU wind power reached 93,957 MW in total installed capacity in 2011, maintaining the growth of the previous year despite the difficult economic climate.

Wind energy is the number one choice in Europe's efforts to move towards clean, indigenous renewable power. Wind energy companies in the EU currently employ 108,600 people; when indirect jobs are taken into account this figure rises to more than 180,000. In Ireland wind energy jobs are concentrated with wind farm developers, some of which have gained strong international positions. The country also boasts a variety of companies specialising in engineering, operation and maintenance personnel, legal services, insurance and finance serving the wind industry. Based on government targets for 40% of Ireland's electricity to come from renewables (mostly wind) by 2020, the wind energy sector is predicted to deliver more than 10,760 jobs through direct and indirect employment. The construction and development of wind energy projects across the island will involve c. €14.75 billion of investment to 2020; c €5.1 billion of which will be retained in the local Irish economy. Of the €5.1 billion it is estimated that c.€4.3 billion will be invested in Ireland and c. €0.8 billion will be invested in Northern Ireland.

The wind power capacity installed in the EU by end 2011 produces 205 million MWh of electricity, satisfying 6% of the EU's electricity demand, and avoids the emissions of 156 million tonnes of CO_2 per year, the equivalent of taking more than 70 million cars off Europe's roads.

1.3. UPPERCHURCH WINDFARM PROPOSAL

The proposal is to construct 22 turbines west of Upperchurch village, Co. Tipperary in the townlands of Graniera, Shevry, Knockcurraghbola Commons, Gleninchnaveigh, Coumnageeha, Knocknamena Commons, Knockmaroe and Grousehall.

These 22 turbines will produce 150 million kWh of green electricity capable of supplying 23,000 houses which is equivalent the domestic electricity requirements of North Tipperary.* The production of 150million kW/h per annum of green electricity would avoid the emission of 128,118tonnes of greenhouse gases per annum which would result from generating the same amount of electricity by fossil fuel plant.

Emission	Every MW of installed capacity of wind energy in Ireland offsets the following amounts of greenhouse gasses per annum that would otherwise be emitted by conventional fossil fuel electricity generation	Approx. Annual Savings Upperchurch Windfarm
CO_2	2,318tonnes	101,992 tonnes
SO_2	49tonnes	2,156 tonnes
NO_x	5.5tonnes	242 tonnes
Ash	175tonnes	7,700 tonnes
Oil		133,333 barrels**

*the average annual household consumption of electricity in Ireland has increased to approx. 6,500 kWh. The population of North Tipperary was 66,023 in 2006 and the average household size was 2.8. (North Tipperary County Development Plan 2010-2016)
**The energy equivalent of 1 kWh of electricity = 3413 Btu = .034 gallons of oil.
***Source:** Wind farms and the Environment, Irish Energy Centre 2004.*

Unlike conventional power sources, the creation of electricity from the wind does not pollute the physical environment; it creates no contribution to climate change or acid rain and emits no radiation or nuclear waste.

Wind energy is an indigenous source of power, which offers security of supply reducing our dependence on imported fuels. According to the annual Energy in Ireland (2012) report published by the Sustainable Energy Authority of Ireland (SEAI) Irish renewable electricity production avoided emissions of 3.6 million tonnes of CO_2 and avoided €300 million in fossil fuel imports in 2011. According to Dr Brian Motherway, Chief Executive of SEAI, 'This is money leaving the country and our economy and brings into sharp focus the continued imperative for an accelerated move away from fossil fuels'.

1.4. PERSONNEL INVOLVED IN THIS ENVIRONMENTAL IMPACT STATEMENT

This Environmental Impact Statement was prepared by:

EIS co-ordination	Ecopower Developments Ltd. Wind Energy Developer
Ecology Appropriate Assessment Natura Impact Statement Geotechnical Assessment Hydrological Assessment Sediment & Erosion Control Plan Noise Impact Assessment	Malachy Walsh & Partners Consulting Engineers
Visual and Landscape Impact Assessment	Mozart Landscape Architects
Telecommunications Impacts	Ai Bridges Ltd
Construction Impacts Air and Climate Impact Residential Amenity Socio-Economic Impacts	Ecopower Developments Ltd.
Cultural Heritage	Kilkenny Archaeology
Technical information	Wind Turbine Manufacturers

1.5. STRUCTURE OF THIS ENVIRONMENTAL IMPACT STATEMENT

This EIS has been structured having regard to Planning and Development Regulations 2001 (Article 94 and Schedule 6), EPA Guidelines on Information to be contained in EIS (2002), EPA Advice Notes – Section 3 Project Type 33, on preparation of EIS (2003) and EIA Directive 85/337/EEC as amended, on the assessment of the effects of certain public and private projects on the environment. All likely impacts are considered in terms of:

- Existing conditions
- Likely significant effects of the development
- Proposals for mitigation of these impacts

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1.6. CONSULTATION

Consultation in the preparation of this report included the following bodies or sources of information:

- North Tipperary County Development Plan 2010 - 2016
- North Tipperary County Council (Planning Department)
- Department of Environment, Heritage and Local Government Wind Energy Guidelines 2006
- Local Landowners
- ESB Networks
- Irish Aviation Authority
- National Parks and Wildlife Service
- National Roads Authority
- Telecoms/Communications Companies

2. European and National Policy Context

2.1. EUROPEAN UNION POLICY

In March 2007 EU Heads of State adopted a binding target of 20 per cent of energy to come from renewables by 2020. Electricity represents approx. one-third of our energy requirement. The other two-thirds of energy is required in the form of transportation and heating. In January 2008, the European Commission released a renewables legislation draft, proposing a stable and flexible EU framework, which should ensure a massive expansion of wind energy in Europe to contribute to the electricity requirement.

Within such a positive policy framework wind power achieved an installed capacity of 93,957 MW in the EU-27 by end of 2011. This represents an overall contribution to electricity supply of 6.3%. By 2020, this figure is expected to increase to 12–14%, with wind power providing energy equal to the demand of 107 million European households.

2.2. INDUSTRY AND MARKETS

In 2001, the EU passed its Directive on the promotion of electricity produced from renewable energy sources in the internal electricity market. This is still the most significant piece of legislation in the world for the integration of electricity produced by renewable energies, including wind power. This directive contained an indicative target of 21% of final electricity demand in the EU to be covered by renewable energy sources by 2010. This directive also regulates the electricity markets. It has been tremendously successful in promoting renewables, particularly wind energy, and is the key factor explaining the global success of the European renewable energy industries and the global leadership position of European wind energy companies. The gradual implementation of the 2001 Renewable Electricity Directive in the Member States, as well as the unanimous decision made by the European Council at its Spring Summit in March 2007 for a binding 20% share of renewable energy in the EU by 2020, are all steps in the right direction and indicators of increased political commitment.

A new directive, based on a European Commission proposal from January 2008, was adopted by the European Parliament and Council in December 2008. It will raise the share of renewable energy in the EU from 8.5 per cent in 2005 to 20 per cent in 2020, which means that more of the EU's electricity will have to come from renewables in 2020. It is already clear that wind energy will be the largest contributor to the increase in electricity produced from renewable sources.

Ireland has binding legal obligations under EU Directive 2009/28 EC to ensure that 16% of all energy consumed in Ireland across the electricity, heat and transport sectors is from renewable sources by 2020. The National Renewable Energy Action Plan sets out that the 16% overall will be achieved by around 40% of electricity consumed being from renewable sources, 12% of consumption in the heat sector and 10% consumption in the transport sector.

2.3. THE EU ENERGY MIX

While thermal electricity generation, totalling over 430 GW, has long served as the backbone of Europe's power production - combined with large hydro and nuclear, Europe is steadily transitioning away from conventional power sources towards renewable energy technologies. Between 2000 and 2011, total EU power capacity increased by 364 GW, reaching 939 GW by the end of 2011. The most notable changes in the mix were the near doubling of gas capacity and wind energy more than quadrupling.

2.4. WIND ENERGY IN THE EUROPEAN POWER MARKET

The EU is leading the way with policy measures to facilitate the move towards the deployment of renewable energy technologies. With a compound annual growth rate of over 20 per cent in MW installed between 2000 and 2011, wind energy has clearly established itself as a relevant power source in Europe's electricity generation market. In 2011, 21% of EU capacity installed was wind power, and wind power increased more than any other power-generating technology in Europe, including natural gas. Wind power's share has jumped to over 6.3% of total installed capacity and and surpassing 10 per cent in Ireland, Spain and Denmark.

2.5. EU AND THE NATIONAL DEVELOPMENT PLAN (NDP 2007-2013) COMMITMENTS ON RENEWABLE ENERGY

The Sustainable Energy Sub-programme of the National Development Plan (2007-2013) reflects EU renewable energy target in that it pledges

> *renewable energy measures focusing on achieving Government targets for renewable energy production and meeting policy goals with regard to competitiveness, environment, security of supply, R&D and the development of a sustainable All-Island energy market. The primary focus will be on the large-scale deployment of wind.*

In the *State Energy Companies Sub-Programme* the plans for Eirgrid are that

> *During the period 2007-2013, the main focus of investment by Eirgrid will entail improvement of the transmission network for electricity to accommodate increased usage and enhance security of supply, to allow increased connection of sustainable and renewable energy sources to the network and to support greater interconnection with Northern Ireland and Great Britain. Expenditure of some €770 million is envisaged on the transmission system over the period of the Plan.*

2.6. RENEWABLE ENERGY FEED IN TARIFF (REFIT)

The renewable energy feed in tariff (REFIT) scheme was launched in May 2006 by the Department of Communications, Marine (now Energy) and Natural Resources. The REFIT scheme had an announced target of supporting 400MW (with potential to increase this figure depending on demand and uptake of capacity on existing competitions) in order to encourage renewable energy projects through providing a fixed-price support to electricity suppliers purchasing electricity generated from renewable resources, such as biomass, hydropower and on-shore wind energy.

REFIT requires an electricity supplier to enter into a 15 year Power Purchase Agreement (PPA) with the electricity generator. The supplier receives a Reference Price which is a fixed price support from the government. The Reference Price for Large Scale Wind projects is 5.7 eurocents per kWhr. This scheme is in contrast to the previous government schemes to encourage renewable electricity production, which were run on the basis of generators tendering for ESB fixed price PPAs in a price-based "Dutch auction" competition.

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In September 2006 the Minister announced REFIT support for 55 new renewable electricity generation projects, 98% of which were wind energy projects, totalling more than 600MW. REFIT has continued to expand. A total generation capacity from wind energy of 1,642MW was connected to the national grid by December 2011.

On announcing the scheme in May 2006, Noel Dempsey the then Minister for Communications, Marine, and Natural Resources said that

> *"harnessing renewable energy is an essential part of delivering on our Kyoto obligations…the target set is challenging but achievable. It is my intention not to limit our ambition to the achievement of short-term targets but to develop this sector in an ambitious yet realistic manner. We will be considering targets for post 2010 in the context of the green paper on energy which I will be publishing mid year."*

This Green Paper "Towards a Sustainable Energy Future for Ireland" was published in October 2006. In the Green Paper the Government commits to a significant growth in renewable energy. A 2010 target of 15% (increased from 13.2%) of electricity consumption to be met by renewable energy was announced with a further target of 33% of penetration of electricity generated by renewable resources by 2020 being set in the Irish Government's Energy White Paper 2007.

The White Paper makes clear that renewable energy will be a critical and growing component of Irish energy supply to 2020 and beyond. Renewable energy will be an integral part of our climate change strategy and sustainability objectives. The Paper recognises the additional diversity which renewables bring to Ireland's energy demand which will also make a direct contribution to the Paper's goal of ensuring secure and reliable energy supplies.

2.7. CONCLUSION

There is a clear environmental imperative and an increasing economic and security of supply imperative, to the development of renewable energy sources. Over one-fifth of new electricity generation capacity installed in Europe in 2011 was wind energy electricity generation.

A binding target of 20% of all energy coming from renewable sources has been set for the EU to achieve by 2020 by the EU Renewable Energy Directive 2001/77/EC, which would mean approximately 35% of electricity coming from renewables by then. The Renewable Energy Directive creates a legislative framework in all Member States up to 2020 and has had a positive effect on the European wind industry.

In compliance with the EU Directive on the promotion of electricity produced from renewable sources Ireland committed to a national indicative target in the National Development Plan (NDP 2007-2013) of a contribution of 15% of green electricity to total electricity consumption by 2010. This target was increased to 33% of total electricity consumption by 2020 in the Energy White Paper 2007.

Renewable energy measures in the NDP focus on achieving Government targets for renewable energy production through the large-scale deployment of wind. The NDP commits investments by Eirgrid to improve the transmission network to accommodate increased connection of sustainable and renewable energy sources to the network.

The Energy White Paper envisages continuing increased penetration of renewables in electricity production which will reduce our impact on the environment and enhance the diversity of our fuel supply.

3. The Proposed Development

3.1. LOCATION OF THE PROPOSED DEVELOPMENT

The proposal is to construct 22 turbines in the townlands of Graniera, Shevry, Knockcurraghbola Commons, Gleninchnaveigh, Coumnageeha, Knocknamena Commons, Knockmaroe and Grousehall west of Upperchurch village, Co. Tipperary. For clarity of nomenclature this proposal is described throughout as the Upperchurch Windfarm.

The Upperchurch windfarm is proposed for an area within a series of small hills 2km west of Upperchurch village and 18km to the west of Thurles, County Tipperary. It lies just north of the main road between Limerick and Thurles, which dissects the mountains from west to east and almost borders Milestone on its south-western extent. Milestone is on the regional road from Tipperary Town to Nenagh, which passes from north to south through the Silvermine Mountains.

See **Figure 3.1 Site Location Map** at the end of this chapter.

3.2. DESCRIPTION OF PROPOSED DEVELOPMENT

3.2.1. *GENERAL*

The Silvermine Mountains comprise many rounded peaks, with intervening valleys of sloping pasture and winding rivers and streams and extend over an area of c.330km^2. The proposed turbines are arranged in four clusters within an overall area of 12km^{2}on the eastern margins of these mountains.

The proposal is to construct 22 wind turbines together with ancillary service roadways and a 110kV substation compound. It is planned to access the site at Graniera, 1km before Milestone, at Site Entrance No. 1. From this point the construction vehicles will access the full site using newly built windfarm roadways, upgraded farm and forestry tracks and site entrances from the Third Class Road network within the site area. The electricity generated will be cabled underground to the windfarm control building in Knockcurraghbola Commons. See **Figure 3-2: Site Layout Map** at the end of this chapter.

3.2.2. *WIND TURBINE CHARACTERISTICS*

The turbines will be of the generic, three-bladed, tubular tower model. For the purpose of the planning submission the layout and Zones of Visibility and Photomontages have been based on a turbine with an overall height of 126.6m.

3.2.3. *LAND USE AND SITE PLAN*

The site plan **Figure 3-2: Site Layout Map** shows the access roads, turbine placements and the windfarm sub-station compound containing the control building, main transformer and end -mast. The turbines are numbered 1 to 22 and are referred to, throughout this report and on the drawings, as T1, T2….T22. The proposal is to locate the turbines on a series of small hills or drumlins ranging in elevation from 280m to 401m OD. The development is set out generally over four areas. The first area, to the north east comprises 8 turbines, the second area to the south east comprises 8 turbines, the third area to the west comprises 5 turbines and the fourth area in the centre comprises 1 turbine. The landcover in the area comprises predominantly pasture fields, forestry and frequent areas of bog/reeds. The area is rural with a dispersed population.

The turbine placement on the site is dictated by the topography of the site, visual design criteria, the direction of the prevailing winds and spacing between the individual turbines and between the turbines and the nearest residences and site boundaries.

3.2.4. *PLANNING HISTORY OF WIND FARMS IN THE AREA*

All existing windfarms in the surrounding area are included in the list below along with all windfarms that have received planning permission or an extension to duration of planning permission within the last 5 years. All projects listed below comprises the windfarms shown in the Visual Impact Assessment Photomontages of this EIS.

Falleennafinoga Windfarm

2-turbine development at Turraheen Upper which is 2km south of the proposed site. South Tipperary Planning Ref. 04/1178. Construction has commenced on this project.

Hollyford Windfarm

3-turbine development at Glenough Upper which is 2km south of the proposed site. South Tipperary Planning Ref. 05/287. Construction has not yet commenced on this project.

Glenough Windfarm

There is an operating windfarm of 13 turbines at Glenough Upper/Lower and Turraheen Upper/Lower which is located 3km to the southeast of the proposed site. Planning Ref. South Tipperary 04/1195&08/701. This windfarm was commissioned during 2011. Planning permission was granted in 2011, for a 1-turbine extension to the windfarm. Construction commenced on this turbine in August 2012.

Glencarbry Windfarm

9-turbine development at Glencarbry/ Piperhill/ Glenpaudeen/ Foilmacduff/ Glenough Lower which is 6km south of the proposed site. South Tipperary Planning Ref 07/255. Construction commenced on this project in September 2012.

Cappawhite Windfarm

8-turbine development (South Tipperary Planning Ref. 07/364) and a further 10 (Ref. 11/6) at Cappagh, Parkroe, Kilmore, Oldcastle and Moher which is 10km to the southwest of the proposed site. Construction has not yet commenced on this project.

Garracummer Windfarm

13-turbine development at Curraghmarky, Birchgrove, Moanvaun, Garracummer, Cummer More and Cummer Begwhich was later combined with permission for 2 turbines at Tooreen. This area is 4km southwest of the proposed site. South Tipperary Planning Ref. 04/1259 & 04/1034 respectively. Construction commenced on this project in 2011.

Knockastanna Windfarm

Operational windfarm of 4 wind turbines at Curraghafoil, Doon, County Limerick. Limerick County Council Reg No. 01/1385

Knockmeale Windfarm

Planning permission was granted for 2 turbines at Lisgarriff, Knockmeale. (North Tipperary Planning Ref. 07/51/0779) in 2009. This area is 7km north west of the proposed site. This windfarm is under construction.

Curraghgraigue Windfarm

The Curraghgraigue windfarm was extended to 6-turbines under North Tipperary planning permission No. 4/51/1665. This area is 9km north west of the proposed site. This windfarm is operational.

3.2.5. *ALTERNATIVES CONSIDERED*

The EPA Advice Notes for Project Type 33A - Installations for the harnessing of wind power for energy production do not suggest a specific procedure for describing ‘Alternatives Considered’ for wind farm projects. However in Section 3.2 – Project Description it states that in general alternatives, where relevant, may be described at three levels - alternative locations, designs and processes and the main reasons for choosing the proposed development should be indicated.

3.2.5.1 ALTERNATIVE WIND FARM LOCATION

Section 1 notes on alternative location state that

Some locations have more inherent environmental problems than others. Such sites can usually be avoided in favour of sites which have few constraints and the maximum capacity to sustainably assimilate the development.

Various sites are identified at the prospecting stage and suitable sites are then chosen if they possess a critical combination of essential characteristics. The proposed location was identified as a suitable windfarm site, where there was maximum capacity to sustainably assimilate the development because of 4 factors;

- Mitigating environmental impact factors - no natural heritage designations on site and adequate separation distance between a turbine and the nearest residence.
- Mitigating visual impact elements – The area is identified as suitable for wind farm developments in the Wind Capacity Strategy and Outline Landscape Strategy for

North Tipperary. The Strategy is based on landscape assessment and sensitivity together with wind resource mapping and is based on the findings of the baseline Landscape Character Assessment undertaken for the County by Environmental Resources Management (Ireland) Ltd. The study considered the potential effects of wind farm developments on both landscape character and visual amenity

- Sustainability of the proposal – Within the area zoned in the Wind Capacity Strategy the location was refined to an area with an optimal wind resource. The energy in the wind is a cubic factor of its speed. This means that there is eight times more energy in windspeeds of 10 meters per second (m/sec) compared to windspeeds of 5m/sec. In general average windspeeds on elevated terrain are 50% - 60% higher than speeds on low-lying areas. A wind turbine located on an elevated site will produce the same amount of electricity as 2 similar turbines on lower ground. Building wind farms in the more elevated areas means that fewer turbines are required to produce the optimal output for the area zoned in the Strategy which reduces the amount of raw materials required for both the turbine manufacture process and the building process.

- Adequate site access –construction access can be an issue, particularly in the mountainous areas. The location of this site is suitable because the area can be accessed from the south on haul routes previously used for transportation of components and construction materials for the Glenough Windfarm 3km to the southeast and Garracummer Windfarm 4km to the southeast of the proposal. This will mitigate the level of road widening/realignment that would normally be required to access a windfarm development site.

- Other elevated areas with an adequate wind resource were examined at the prospecting stage but were rejected due to natural heritage designations, unsuitable zoning in the Wind Capacity Strategy for North Tipperary or inadequate site access.

3.2.5.2 ALTERNATIVE WIND FARM DESIGN

Section 1 notes on descriptions of alternative design state;

Most problems will be capable of a number of design solutions by varying the site layout, building massing or location of facilities. Where designers are briefed at an early stage about environmental factors, these can usually be incorporated along with other design parameters.

In the early stages of this proposal the designers positioned the turbines in order to most effectively capture the wind resource, while maintaining both the requisite separation distances between the individual turbines and an adequate separation distance from the nearest houses and taking into consideration communication signals from the Knockmaroe telecommunications mast. This preliminary layout was examined and modified in the context of the results of the Environmental Impact Assessment studies on the site geotechs, hydrology, archaeology, ecology and telecommunications and modifications were made to the design to incorporate any recommendations for mitigation of environmental impacts from the consultants' reports. This iteration of the site was then examined and modified in the context of including as many of the local landowners in the scheme in order to mitigate impacts on the proposed windfarm site's neighbours. Alternative locations within the site boundaries for the windfarm sub-station were examined with a preference to siting the compound at a lower elevation to mitigate visual impact and as near as possible to the grid connection route to reduce overhead line/cable lengths and thus mitigate visual and ecological impact.

Thus an optimum design was reached which was the best fit having consideration for wind resource, residential amenity, landholdings and environmental impacts. The final design accommodates 22 turbines, which are the subject of this planning application.

Various turbine sizes were considered and the 2/3MW size turbine was selected for this project as the dimensions are similar to neighbouring permitted projects. Similarly to the preference for locating wind turbines in elevated areas, building larger and more efficient turbines mean fewer turbines overall. A 10-15% increase in turbine height can increase the energy yield by up to 50%. These more efficient turbines increase our ability to meet greenhouse gases reduction targets, reduce the amount of turbines needed and reduce the amount of raw materials required.

3.2.5.3 ALTERNATIVE PROCESS

A Section 1 notes on descriptions of alternative process state;

Within each design solution there can be a number of different options as to how the processes or activities of the development can be carried out. These can include management of emissions, residues, traffic and the use of natural resources. Consideration of environmental factors can influence the selection of processes which avoid adverse impacts.

Although the process of conversion of the power in the wind to electricity is standard, alternative haul routes and construction activities were examined as part of the alternative process exercise. The haul route already used by previous developments was finalised as the preferred route. Construction activities will only be conducted during daylight hours, 6 days a week and delivery times will be actively managed. This will mitigate disruption to the local community.

3.2.6. *CONSTRUCTION*

The site will be accessed from the Regional Road R503 to the south of the site and through the local road network running through the center and north of the site. The first stage in the construction of the turbines is the construction of the site roads. Then follows the excavation of foundations, fixing the steel reinforcements and pouring the concrete for the foundations and erection of the turbines. The electrical connections are cabled underground to the substation compound and roadway verges are revegetated.

3.2.6.1 SCOPE OF WORKS

- 11.9km of windfarm tracks comprising 8km newly built roads and 3.6 upgraded farm and forestry roads.
- 22 No. concrete turbine bases along with hardstands to facilitate crane operation.
- Electrical cabling to the sub-station compound. The substation compound comprises of a sub-station control building, main transformer and end mast.
- 2 meteorological mast
- 22 wind turbines

3.2.6.2 ON-SITE ROADS

The proposed roads will be a combination of upgraded agricultural and forestry tracks and newly constructed roads. Construction access will be gained from the R503 which is the Regional Road from Thurles to Limerick, at Graniera. There will be access points/road crossings from the local roads at Knockmaroe, Knockcurraghbola Commons, Gleninchnaveigh and Shevry, generally in the centre of the site and at Grousehall generally to the north of the site. These local road access points will be retained for day to day operations. On commissioning of the windfarm, the main construction access from the R503 can be closed for day to day operational access save for occasional deliveries involving major components.

The electricity generated will be cabled underground to the windfarm substation compound in Knockcurraghbola Commons. See **Figure 3.2 Site Layout Map** for the layout of the roads, crane pad areas and turbine placements on the site.

Construction of on-site roads involves removal of topsoil and subsoil. This is stored adjacent to the road for later reinstatement of the verges. Crushed rock will be laid on the excavated hard ground and compacted in layers of 200mm. The edges of the roads will be graded and revegetated. Adjacent to each turbine an area of level hardstanding will be laid to accommodate cranes during assembly of the turbine, occasional major component replacements and for decommissioning.

3.2.6.3 TURBINE BASES

The bases will consist of approximately 345m³ of concrete and 14 tonnes of reinforcement steel. There will be no surface expression of the turbine foundations and they will be covered with stone and topsoil. These areas will be reseeded.

3.3. CONSTRUCTION TIMETABLE

- Civil engineering works - 6 months.
- Electrical works - 4 months, which will be carried out in conjunction with the civil works.
- Turbine erection and commissioning – 16 weeks. Turbines are normally installed when the majority of the civil works are completed.

3.4. GRID CONNECTION

Upperchurch Windfarm has secured access to the grid under the Gate 3 Grid Connection process. The power from the proposed windfarm will be connected to the National Grid at a point on the newly built Killonan to Nenagh 110kV line. The windfarm substation compound is proposed for lower lands at Knockcurraghbola Commons in the south west of the site. The low elevation will help to mitigate the visual impact of the compound.

3.5. MAINTENANCE AND MONITORING PROGRAMME

Technical operation and monitoring activities will be carried out remotely using computers connected to the turbines. Four maintenance personnel will be employed at the Upperchurch site to service, maintain and monitor the turbines for operational safety and performance.

3.6. DECOMMISSIONING

3.6.1. *Envisaged Life of Proposed Works*

The turbines have a design life of 25 years. All the electrical equipment - main transformer and individual turbine transformers, switch gear and control gear have a design life of 40 years. The options after 25 years would be to:

- Refit the turbines with new gearboxes, generators and blades and generate as before
- Repower with the most up to date technology and continue production
- Decommission the wind farm and reinstate the site.

3.6.2. *Decommissioning*

Decommissioning involves dismantling the turbines and restoration of the site.

3.6.2.1 Dismantling the Turbines

Turbine dismantling involves removal of the blade sets, the removal of the nacelle, which contains the gearbox and generator, followed by the removal of the tower sections.

3.6.2.2 Restoration of the Site

Turbine foundations: The turbine foundations can be left in situ as the foundations are below ground level and have a steel cylindrical ring protruding from the foundations up to ground level onto which the turbine tower is bolted. This ring can be cut away and the steel recycled. The foundations can then be covered with topsoil.

Roads: Any roads or hardstands that are not required by the local landowners for agricultural activity can be covered over with topsoil and reseeded.

3.6.2.3 Disposal of Turbines and Foundations

Turbines: The turbine tower consists primarily of steel, which can be completely recycled.

Blades: The blades are mainly made up of composite materials, which can be incinerated for electricity generation/direct heat or disposed of in landfill. Production methods for the blades in modern turbines principally involves the use of epoxy composites. This method helps to reduce emissions from organic solvents, thus appreciably reducing impact on the environment at the production and disposal stage.

Turbine transformers: Transformers can be reused and have a second-hand value of at least their removal costs.

Turbine electrical equipment: The generator comprises copper windings which can be reclaimed and have a high recyclable value.

Waste oil and lubricants: All oil-based waste can be collected from site and recycled.

The ease with which wind turbines can be decommissioned, in comparison with nuclear or fossil fuel fired generating stations is another significant environmental benefit of wind energy.

3.7. CONCLUSION

The proposal is to construct 22 turbines, to be called Upperchurch Windfarm, in the townlands of Graniera, Shevry, Knockcurraghbola Commons, Gleninchnaveigh, Coumnageeha, Knocknamena Commons, Knockmaroe and Grousehall west of Upperchurch village, Co. Tipperary. The windfarm will be accessed from the public road at seven points – Graniera, Knockmaroe, Knockcurraghbola Commons, Shevry, Grousehall and Gleninchnaveigh.The Upperchurch windfarm is proposed for an area 2km west of Upperchurch village and just north of the main road between Limerick and Thurles, at Milestone.

The first stage in the construction of a wind farm is building the on-site roads. This is followed by excavation of foundations, pouring of concrete and the erection of the turbines. The electricity generated by the turbines will be cabled underground to the windfarm control building located in the substation compound at the southwest of the site. The windfarm will be connected to the National Grid at the Killonan Nenagh 110kV line c.20km to the west of the substation compound.

Technical operation and monitoring activities will be carried out remotely using computers and there will also be four full time maintenance personnel employed to monitor and maintain turbine operational safety and performance.

The turbines have a design life of 25 years. All the electrical equipment - main transformer and individual turbine transformers, switch gear and control gear have a design life of 40 years. The options after 25 years would be to retrofit the turbines and continue generating or to decommission the wind farm and reinstate the site.

FIGURE 3-1: SITE LOCATION MAP

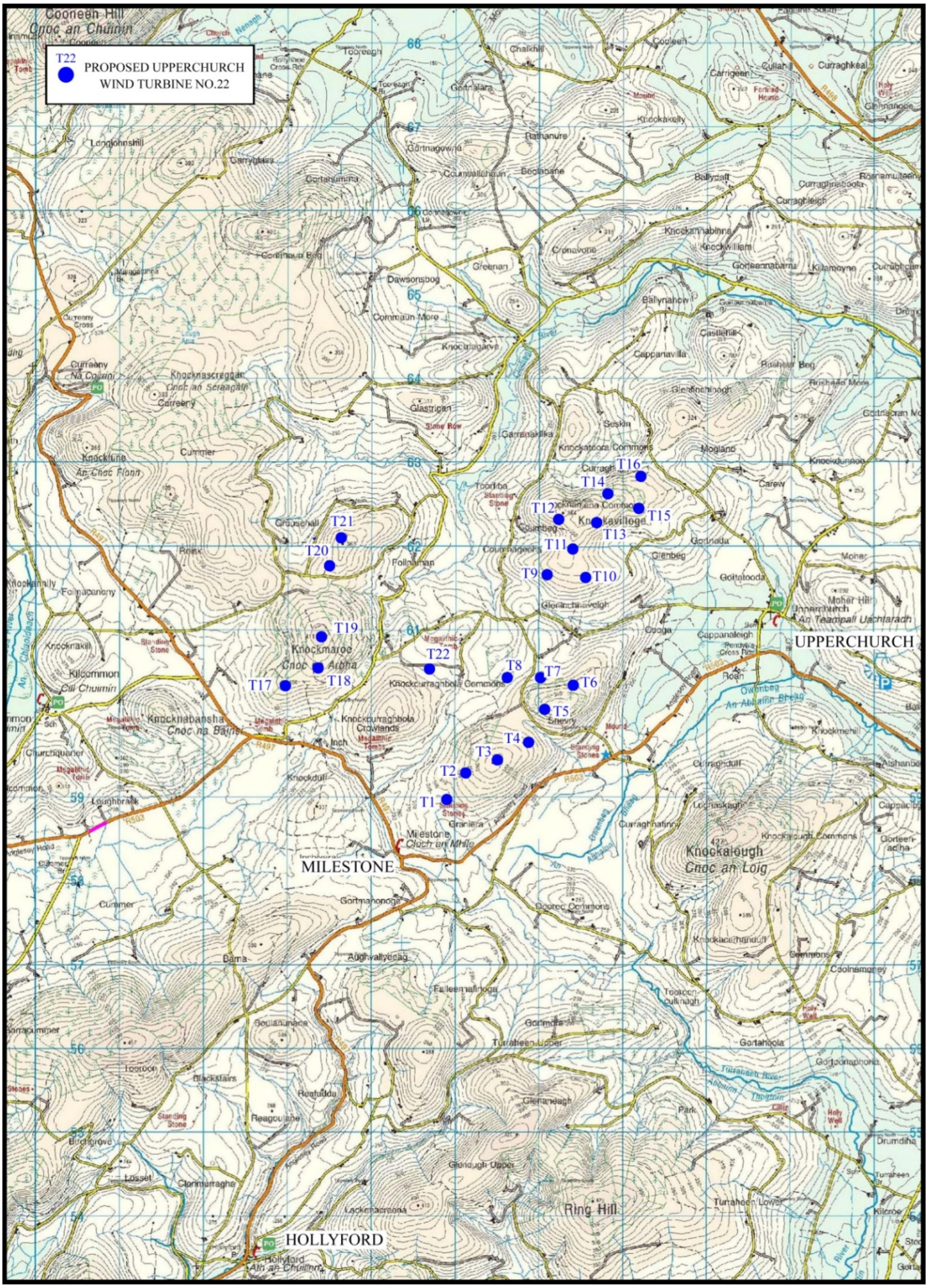
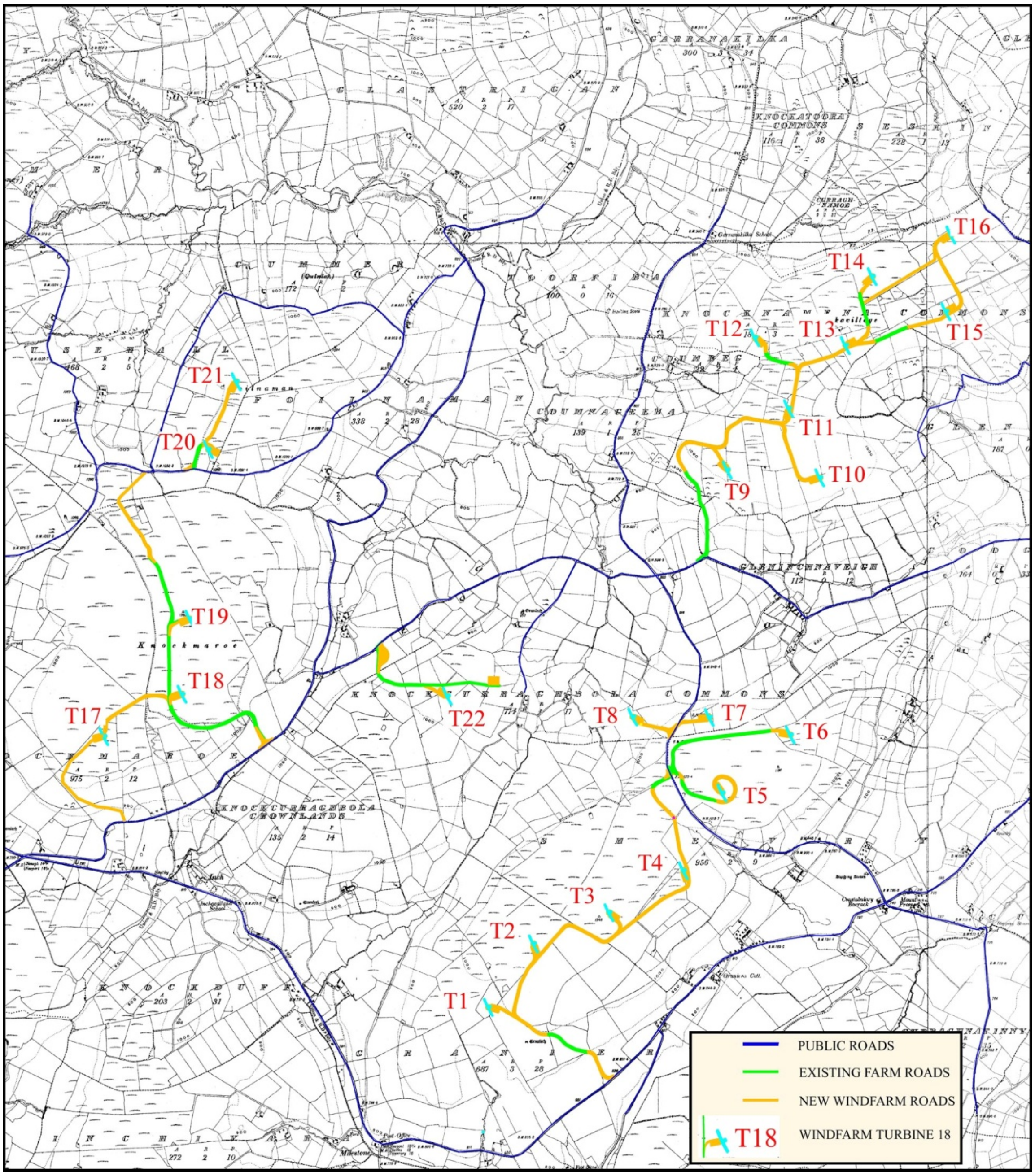


FIGURE 3-2: SITE LAYOUT MAP



Upperchurch Windfarm Environmental Impact Statement

4. Site Selection Process

4.1. SUITABLE CHARACTERISTICS OF UPPERCHURCH WINDFARM SITE

The following characteristics combine to make the Upperchurch turbine sites suitable;

4.1.1. *The Wind Resource.*

The turbine sites are elevated between 290m and 401m and can thus avail of a favourable wind regime.

The first comprehensive Wind Atlas for Ireland was published in October 2003. This atlas was commissioned by Sustainable Energy Ireland and funded by the National Development Plan and European Union Structural Funds. It was produced by ESB International and Truewind Solutions. In the atlas the wind resource is evaluated county by county. These evaluations had regard to elevation, exposure to the prevailing winds and roughness of the surrounding terrain and are represented by maps showing the estimated mean wind speeds and mean power density at 50m, 75m and 100m hub height.

The wind resource is seldom a steady, consistent flow. It varies with the time of day, season, height above ground, and type of terrain. An area's surface roughness and obstacles are also important determinants in wind resource. High surface roughness and larger obstacles in the path of the wind result in slowing the wind and creating turbulence. Wind speed generally increases with height above ground. The power density or energy in the wind is calculated by the frequency at which the wind blows at each speed distribution. Power Density is a useful way to evaluate the wind resource available at a potential site. The wind power density, measured in watts per square meter of swept area, indicates how much energy is available at that site for conversion by a wind turbine.

The Wind Atlas for Ireland contains maps for the Annual Mean Power Density for each county at 50m, 75m and 100m hub-height. The 75m above ground level mean power density map was chosen as reference for the development potential in North Tipperary. Hub heights of c.75m and above are the industry standard for high capacity turbines on inland sites. The wind resource development potential in North Tipperary is concentrated in the elevated areas of the county. Upperchurch and surrounds are in an area with an Annual Mean Power Density in excess of 750 Watts/sq.m which would be considered commercially viable under current economic conditions.

Ecopower Developments Ltd has commissioned wind analysis studies from Garrad Hassan for the general area using data gathered from various meteorological masts installed in the area, the results of which confirm that a viable wind resource exists there. Garrad Hassan are renewable energy consultants and have been providing independent technical services to promoters and financiers of the wind energy industry for over two decades.

4.1.2. *Ease of Access:*

There is adequate access for construction and operational traffic to the site. Construction traffic can access the site from the Thurles to Limerick road at Graniera, south of the site. Access for construction and operational traffic is available from the Local Road at Knockmaroe, Knockcurraghbola Commons, and Gleninchnaveigh and road crossings on the Local Road at Shevry and Knockcurraghbola Commons, all generally in the centre of the site, and also on the Local Road at Grousehall generally to the north of the site.

4.1.3. *County Development Plan Zoning:*

The site is in an area zoned for wind farm development in the Wind Capacity Strategy which was adopted by the Council in 2009. The wind farm is proposed for the area Upperchurch – Kilcommon Hills as detailed in the Strategy. The Strategy states that this area has extensive capacity to absorb wind farm development and that windfarms of a bigger scale are acceptable.

4.1.4. *Site Ecology:*

The site is not part of a designated or proposed designated Natural Heritage Area (NHA), candidate Special Area of Conservation (c.SAC) or Special Protection Area (SPA).

4.1.5. *Visual Impact:*

The surrounding undulating topography provides screening for the development and high banks and hedgerows allow only intermittent views within a 5km radius. The landscape context is one of a working landscape with many anthropogenic elements, including wind turbines, communications mast, electricity and telephone lines, once off rural housing and farmsteads, farms buildings and roads. This setting provides a relatively high visual absorption capacity.

4.1.6. *Telecommunications' Signals:*

The turbine layout takes into account the signals which are transmitted from the telecommunications mast at Knockmaroe. A communications impact study was carried out and adjustments to the turbine locations were possible at the design stage. The final layout is predicted to have no effect on the communication signals in the area.

4.1.7. *Access to the Grid Network and to Grid Connection Agreement:*

There are grid connection options for the project at Upperchurch. The electricity can be transported to the National Grid by a combination of cable and overhead line to a connection point on the Killoan to Nenagh 110kV line. The project has secured access to the National Grid in the Gate 3 Grid Connection process operated by ESB Networks.

Upperchurch Windfarm Environmental Impact Statement

4.2. SITE SUITABILITY CONCLUSION

The area is identified as having a commercially viable wind regime in the Irish Wind Atlas and by independent analysis consultants, Garrad Hassan. There is access available from the nearby public road network. The site itself is not within an NHA, c.SAC or p.SPA. The area is zoned as suitable in the Wind Capacity Strategy for the County. T The anthropogenic nature of the surrounding topography mitigates the visual impact of the development. The Upperchurch Windfarm has secured a Connection Agreement in the Gate 3 grid connection process.

The wind resource of North Tipperary can be developed providing benefit for:

- Local landowners through long term annual land lease payments
- Local Authority area through commercial rates
- Local community through an annual community contribution payment.
- North Tipperary by increasing the county's contribution to installed capacity of renewable energy in support of National and EU policy.
- Electrical and mechanical service providers in the South-East, South-West and Mid-West Regions during the operation and maintenance period following construction
- The Regions during the construction phase through an additional €20 million being spent on civil, electrical, engineering, project management, legal and accounting services. Construction workers will increase business for the local hospitality sector.
- National interest by improvement in the balance of payments through the generation of electricity using an indigenous fuel and by helping to meet our Kyoto commitments on greenhouse gases emission reductions.
- Global interest in helping to reduce the environmental impact of electricity generation.

5. North Tipperary County Development Plan 2010-2016

5.1. NTCDP (2010-2016) GENERAL POLICY WIND ENERGY DEVELOPMENT

County Development Plan Policy: General policy on wind energy developments is stated in Chapter 7 Infrastructure and Services in **Section 7.13.5(ii) Renewable Energy Sources, Item A - Wind Energy.**

In Section 7 it is acknowledged that at present wind energy is the principal renewable inland resource which is accessible to technology. It is stated that the Council will have regard to The Department of the Environment, Heritage and Local Government Wind Energy Guidelines (2006) whilst it endeavours to achieve a reasonable balance between responding to overall positive Government policy on renewable energy and enabling the wind energy resources of the Planning Authority's area to be harnessed in a manner that is consistent with proper planning and sustainable development.

Site suitability is identified as an important factor in determining the suitability of wind farms, having regard to possible adverse impacts associated with for example, residential amenities, views or prospects, public rights of way, wildlife, habitats, special areas of conservation, protected structures, bird migration paths, aircraft flight paths or disturbance by reason of noise, electromagnetic interference or visual impact. In this regard the Council produced a Wind Energy Strategy for the county which was adopted by the Council in 2009. This Strategy identifies areas suitable and unsuitable for wind energy under the following categories:

1. **Areas of the County that have adequate wind resources for wind farm development**

   Areas deemed eminently suitable for wind farm development subject to normal planning considerations.

2. **Areas of the County with adequate wind resources but deemed unsuitable for wind farm development**

   Areas identified as particularly unsuitable for wind farm development. This category isused for areas which due to their scenic, ecological, historic or tourism values are unable to accommodate wind development.

Upperchurch Windfarm proposal: The Upperchurch windfarm proposal is examined in the context of meeting the requirements of the Wind Energy Guidelines (2006) in the following chapter - Chapter 6.

In the preparation of this Environmental Impact Statement an Environmental Impact Assessment, Appropriate Assessment and Natura Impact Statement were prepared by Malachy Walsh & Partners (MWP) Engineering and Environmental Consultants. During this process possible adverse impacts as listed above were examined.

The Upperchurch area of the windfarm site is identified in the Wind Capacity Strategy as having extensive capacity to absorb wind farm development and that windfarms of a larger scale are acceptable.

5.2. NTCDP (2010 – 2016) CHAPTER 10: DEVELOPMENT MANAGEMENT GUIDELINES AND STANDARDS

County Development Plan Policy: Chapter 10 of the County Development Plan sets out the development management and design standards which will be applied by the Council in assessing development proposals. The Guidelines for wind farms is contained in **Section 10.13 Wind Farms.**

5.2.1. *NTCDP Section 10.13 – Windfarms*

Section 10.13 states that the Council will assess windfarm development applications having regard to the DoEHLG Guidelines for Planning Authorities on Wind Energy Development 2006, the Landscape Character Assessment and Wind Capacity Strategy and Landscape Strategy for North Tipperary, 2009.

Upperchurch Windfarm Proposal: The proposal is examined in the context of the Wind Energy Guidelines in the following chapter – Chapter 6. Examination of the recommendations of the Landscape Character Assessment and Wind Capacity Strategy and Landscape Strategy for North Tipperary 2009 follows in this Chapter at Section 5.3.

Further it is stated in Section 10.13 of the CDP that the following criteria need to be addressed by planning applications for wind farm developments:

5.2.1.1 Environmental Impact / Impact on Natural Heritage (10.13.1)

An Environment Impact Assessment (EIA) is required to be submitted with wind farm planning applications. In addition any wind farm development that is likely to have an impact on a SAC or SPA should be accompanied by an Appropriate Assessment. Where proposal falls within a conservation designation, the developer is advised to consult with the DoEHLG prior to making an application.

Upperchurch Windfarm Proposal: An EIA was conducted and the assessment is described in this Environmental Impact Statement (EIS). An Appropriate Assessment was conducted to assess any impact on designated sites in the area. This Appropriate Assessment and accompanying Natura Impact Statement is contained as **Appendix 13-II** in Chapter 13. The proposal does not fall within a conservation designation.

5.2.1.2 Exclusion Zones (10.13.2)

Exclusion zones are set out in table 10.9 (below) in order to protect the visual and residential amenities of the area. New developments are required to comply with these exclusion and separation zones.

Table 10.9 Exclusion & Separation Zones

Exclusion Area	Exclusion Distance (m)
Towns, villages	1,000
National Primary	300

National Secondary	200
High voltage cables	200
Lakes > 6 Ha	2,000
Primary amenity areas Secondary amenity areas	See County Designations map
Boundary set back to turbines	1.5 x turbine height
Separation between turbines	3 x turbine height

** **CDP note under Table 10.9** Boundary set back and separation distances between turbines may vary depending on total height of turbines and rotor diameter.*

Upperchurch Windfarm Proposal: The proposal can comply with all the exclusions detailed in Table 10.9 quoted above in the following manner.

Exclusion Area	**Exclusion Distance (m)**	**Upperchurch Windfarm Proposal**
Towns, villages	1,000	No towns or villages within 1000m. (Upperchurch 2,000m distant)
National Primary	300	No National Primary Routes within 300m
National Secondary	200	No National Secondary Routes within 200m
High voltage cables	200	No HV cable within 200m
Lakes > 6 Ha	2,000	None within 2,000m. (Lough Derg > 20km distant)
Primary amenity areas Secondary amenity areas	See County Designations map	Not in an amenity area. Nearest area > 20km to the west.
Boundary set back to turbines	1.5 X turbine height	Set back distance of 189m has been achieved at all but one turbine site. T17 is 60m from a neighbouring boundary.
Separation between turbines	3 x turbine height	Separation distance = 379m A minimum separation distance of 379m has been achieved.

Note: Turbine height to tip height (126.6m) is the turbine height used in the compliance table above.

5.2.1.3 Visual Impact (10.13.3)

This section states that because of the scale of development, wind farms can have a significant visual impact and should be sited by taking account of the character and sensitivity of the landscape as outlined in the North Tipperary County Council Landscape

Character Assessment. A Visual Impact Statement and Photomontages from key focal points, such as nearby settlements, tourism sites and protected structures are required to be submitted.

Upperchurch Windfarm Proposal: The character and sensitivity of the landscape in the Upperchurch area is described in the North Tipperary County Council Landscape Character Assessment as Landscape Character Type 6: Farmed Foothills and Landscape Character Area LCA 7: Upperchurch - Kilcommon Hills where wind energy developments are listed as a probable force for change.

The character and sensitivity of the landscape is described as a working landscape and highly scenic owing to the varied and interesting topography of rolling hills and valleys. However it states that the nature of the varying topography is such that there is a capacity to accommodate development without undue deterioration in the scenic quality.

The windfarm will be visible, although intermittently because of the rolling topography, from Views and Prospects as designated in Appendix 5: List of Protected Views of the CDP. The significance of the visibility of the proposal from these points is assessed by Mozart Landscape Architects in the Visual Assessment Chapter 11 and illustrated in Photomontages in that Chapter.

It is recommended in the Landscape Character Assessment of NTCDP, that criteria for the wind energy development and layout should be provided in order to manage this landscape. These criteria are set out in the Wind Capacity Strategy and Landscape Strategy for North Tipperary 2009 where the proposed wind farm development is in an area where the Strategy states that there is extensive capacity to absorb windfarms. The Strategy further states that an increase in scale would result in a more successful layout, responding to the landscape pattern which is bigger in scale than that found elsewhere in the county.

5.2.1.4 Roads (10.13.4)

It is recommended that access roads within the site be unsurfaced and follow the natural contours of the site and it is noted that roads providing access to the site may require widening and resurfacing to facilitate construction. Provision is made for the application of a Special Contribution in accordance with Section 48 of the Planning and Development Act for the purpose of up-grading/improvement of works along the route corridor for the construction of the wind farm and to facilitate the development.

Upperchurch Windfarm Proposal: The access roads within the site will be unsurfaced and will follow the natural contours of the site as far as is possible. The application of a Special Contribution can be subject of a Planning Condition.

5.2.1.5 Connection to the Grid (10.13.5)

It is a requirement that proposals for wind farms are accompanied by indicative option(s) for grid interconnection lines and associated facilities. Evidence that an application has been made to the relevant statutory provider should accompany the planning application.

Upperchurch Windfarm Proposal: Ecopower Developments Ltd applied for a grid connection for a windfarm in the area in 2004 (DG96). A Grid Connection Offer for the area, in the Gate 3 Grid Connection Process, was issued to Ecopower Developments by ESB Networks in 2010.

Under grid connection rules, which are determined by the Commission of Energy Regulation (CER), a particular Grid Connection must connect to a defined node on the National Grid but the specific location of the generation plant/windfarm is more flexible.

Under the Grid Connection Offer (Agreement Number: 6002910592 Gate 3 Ref. DG96) it is proposed to connect this windfarm to the National Grid at a point along the Killonan to Nenagh 110kV Transmission line. The point of connection and method of construction of the connection line will be determined by E.S.B. Networks and will be either fully cabled underground or will be a combination of underground cable and overhead line.

5.2.1.6 Shadow Flicker / Noise (10.13.6)

This section states that proposals for wind turbines within 500m of a dwelling house must demonstrate that the orientation of the house, its private amenity space and disposition of windows is such that the dwelling will be largely unaffected by shadow flicker and not be seriously injurious to the amenity of the dwelling. Proposals must also demonstrate that the residential amenity will not be impacted by virtue of noise and all applications should be accompanied by a Noise Impact Statement of noise sensitive locations such as occupied dwellings.

Upperchurch Windfarm Proposal: It is stated in the DoEHLG Wind Energy Guidelines that at distances greater than 10 rotor diameters from a turbine, the potential for shadow flicker is very low. All houses within 900 meters of a turbine have been modelled for the amount, if any, of shadow flicker effect. The results of this modelling is detailed in Chapter 10 Residential Amenity.

A Noise Impact Study was commissioned from Malachy Walsh, Consultant Engineers to assess the impact on all noise sensitive locations in the area. This study is detailed in Chapter 10 Residential Amenity and **Appendix 10-I** of this EIS.

5.2.1.7 Landscape Character Assessment of North Tipperary

In December 2004, Environmental Resources Management Ireland (ERM) in association with ERA-Maptec Ltd was commissioned by North Tipperary County Council to prepare a Landscape Character Assessment of North Tipperary. The study was prepared in accordance with the Landscape Guidelines from the Department of Environment and Local Government. The objective of the study was to complete a thorough assessment of the character, value and sensitivity of North Tipperary's landscape in order to provide the basis for assessment and classification of the landscape in order to inform policy formulation and decision-making regarding landscape management in the County.

The Landscape Character Assessment is divided into five sections:

1. Chapter One – Introduction
2. Chapter Two - The Evolution of the North Tipperary Landscape where the principal forces that have shaped the North Tipperary landscape are described along with important and distinctive geological, cultural and habitat features and their distribution.
3. Chapter Three - The Present Day Landscape of North Tipperary. This chapter provides the definition and identification of Landscape Character Types (LCTs) found

within the County. A description of each LCT is presented, accompanied by an initial identification of forces for change for each LCT.

4. Chapter Four - A presentation of each geographical Landscape Character Area (LCAs). These presentations are accompanied by written descriptions on formative influences, elements and features defining each LCA, including human influences, principal forces for change, current condition of the landscape and sensitivity to change. Characteristics that are particularly distinctive, rare or vulnerable are identified.
5. Chapter Five - Forces for Change. This chapter discusses the forces for change operating currently on the landscape and discusses them in terms of landscape implications, policy directions and recommendations for landscape management.

The proposal is examined below in the context of Chapter Three, Four and Five of the Landscape Character Assessment.

5.2.2. *Chapter Three - The Present Day Landscape of North Tipperary*

5.2.2.1 Landscape Character Types (LCTs)

Landscape Character Types (LCTs) are discussed in detail here. LCT are distinct types of landscape that are relatively homogenous in character. Where they occur they share similar combinations of geology, topography, land cover and historical landuse.

The proposed windfarm site is located in the Upperchurch/Kilcommon area which is a large area of LCT 6: Farmed Foothills as illustrated in Figure 7 of the Landscape Character Assessment. The location of the application site is shown in the context of Figure 7 (of the Landscape Character Assessment) in **Figure 5-1: Landscape Character Type of Proposed Windfarm Site** at the end of this Chapter.

The distinct LCT are described under 4 headings. LCT 6: Farmed Foothills is described as

Landscape Character Type	Key Drivers	Description	Forces for Change
6. Farmed Foothills	Topography is steep sided at the highest elevations Elevation ranges from 200m to 450m Geology generally comprises Silurian Greywackes and slates with some Devonian old red sandstone at lower elevations. Land cover is largely	An incised landscape comprising rolling prominent hills with localised valleys between. Tracts of commercial forestry are a frequent feature in this hilly terrain, the larger plantations generally being located on hilltops. In general, the dominant landuse on the hills is pasture. The pastoral landscape is in good condition comprising fields at a medium to large	Commercial coniferous forestry Potential for development of windfarms and Government Renewable Energy policy. Development of visibly obtrusive single dwellings in the

	blanket bog and commercial afforestation	scale bounded by deciduous hedgerows containing some mature trees. Rivers and watercourses are a feature of this landscape albeit not usually visually prominent. These are typically fringed by deciduous vegetation. Pockets of woodland with scrub under storey can be found. These are generally at lower elevations and associated with the Rivers Bilboa and Owenboy. Dwellings are relatively sparse and comprise a mixture of traditional farmhouses and more modern dwelling houses.	countryside.

The subject site follows the descriptions for Farmed Foothills. The site is within a series of small hills or drumlins. The hills are at elevations of between 350mand 400m and the peaks are generally at heights of 100m above the intervening lower terrain. The highest peak is that of Knockmaroe at an elevation of 411m. The principal land use within the surrounding area is pasture (dairy farming and dry cattle). Some blocks of conifer plantation occur within the site.

The development potential for windfarm projects is recognised as a force for change in this landscape.

5.2.3. *Chapter Four - Landscape Character Area (LCAs)*

The County is divided into geographical Landscape Character Areas (LCAs) based on the Landscape Character Types described in Chapter Three of the Landscape Character Assessment. LCAs are delineated and are accompanied by written descriptions on formative influences, elements and features defining each LCA, including human influences, principal forces for change, current condition of the landscape and sensitivity to change. Characteristics that are particularly distinctive, rare or vulnerable are also identified.

The subject site is in LCA 7: Upperchurch/Kilcommon Hills as illustrated on Figure 8 of the Landscape Character Assessment. The location of the application site is shown in the context of Figure 8 (in the Landscape Character Assessment) in **Figure 5-2: Landscape Character Area of Proposed Windfarm Site** at the end of this Chapter.

The key characteristics of LCA 7 are that it is a highly scenic pastoral landscape with rolling hills and valleys. It is sparsely populated particularly in the central area with remote character. The elevated points afford extensive views. There is a cluster of prehistoric graves around Rearcross-Kilcommon creating a distinct archaeological landscape of significant value. The principle settlements are on the perimeter of the LCA at Templederry and Borrisoleigh.

The geology of the area is described as principally underlain by Silurian Greywacke and Shale, with Old Red Sandstone on the perimeter. It may be considered part of the wider Silvermines Uplands but the landform is more gentle and composed of rolling hills and valleys. The Bilboa river drains southwards in the LCA, whilst the other principal rivers (the Clodiagh, the Owenbeg and the Turraheen) all drain south easterly before joining the River Suir in South Tipperary.

The landcover is described as pastural, composed predominantly of improved or rushy pasture with some arable lands. Given its lower elevation than the neighbouring LCA, there is no blanket bog although rushy pasture and wetland pockets are located in the lower areas and adjacent to the numerous streams and rivers draining this area. There are plantations of coniferous forestry on the more marginal lands. A gradation is apparent between improved pasture on lower slopes, with pockets of wetland and riparian vegetation, and as elevation increases, there is more rough grazing, and an increase in coniferous planting on the summits of these hills.

In terms of nature designations, this area supports two SACs, with a NHA designation at the Nenagh River Gorge east of Cooneen Hill. There are Four SACs within 10km; Bolingbrook Hill, Anglesey Road, Lower River Shannon and Lower River Suir.

The human influences on the area are described as the settlements of Borrisoleigh, Templederry and Upperchurch. Single storey dwellings are the dominant style and the number of derelict single storey dwellings is noticeable. There is a presence of stone walls within this area which are frequently earth topped and support a variety of vegetation. In the more elevated areas, high earth banks are present. Fields are usually quite large and geometric. There are several good examples of small cut stone bridges, a distinctive feature in this LCA.

There are a number of stone circles, associated with the Early Bronze Age located around Kilcommon, at Reisk, Rardnogy More and Bauraglana with a possible passage grave underneath a stone cairn on Ballincurra Hill near Templederry. A later Iron Age hillfort exists at Ballincurra Hill.

This LCA lies largely within the Barony of Kilmanagh Upper.

The landscape condition and sensitivity is described as a working landscape featuring pasture as the dominant landuse. It is in very good condition and highly scenic owing to the varied and interesting topography of rolling hills and valleys with vantage points that afford views. Although the scenic quality renders this a significantly sensitive landscape it is stated in the Assessment that the nature of the varying topography is such that there is a capacity to accommodate development without undue deterioration in the scenic quality.

The principal contrary factor in this landscape is identified as coniferous forestry and single dwellings of inappropriate design and which are poorly sited and which reduce the scenic quality of this landscape in localised areas. Scenic views, which are protected, are gained from the R497 road route in the south-western part of this LCA.

Further development of wind energy is listed as one of the forces for change in this area. The recommendation for the management of this landscape in respect of wind energy is that criteria for wind energy development and layout should be provided. These criteria are provided in the Wind Capacity Strategy and Landscape Strategy for North Tipperary which was adopted into the County Development Plan in 2009.

5.2.3.1 Chapter Five - Forces for Change.

This chapter discusses the forces for change operating currently on the landscape and discusses them in terms of landscape implications, policy directions and recommendations for landscape management. It contains a brief review of the principal policies and strategies that provide the context within which the forces for change are likely to emerge, an outline of these forces and a suggested management response. It is stated in the Landscape Character Assessment that separate guidance has been produced in relation to wind energy development that will be subject to a separate consultation process by North Tipperary County Council at a later stage.

The Wind Capacity Strategy and Landscape Strategy for North Tipperary (2009) provides the guidance for wind energy development and layout in the County and is based on the Landscape Character Assessment document. The Strategy was produced in 2006 and adopted into the County Development Plan in 2009. It is incorporated in the current CDP (2010 – 2016).

To summarise the application site Landscape Character Type (LCT6) and geographical Landscape Character Area (LCA7 – Upperchurch/Kilcommon Hills) is identified in the Landscape Character Assessment as having potential for wind energy developments. Further the Upperchurch/Kilcommon Hills LCA7 is identified as having the capacity to accommodate development without undue deterioration in the scenic quality due to the nature of the varying topography of the area.

5.3. WIND CAPACITY STRATEGY AND OUTLINE LANDSCAPE STRATEGY FOR NORTH TIPPERARY

Section One of this document comprises the Wind Capacity Strategy for North Tipperary and Section Two comprises the Outline Landscape Capacity.

5.4. WIND CAPACITY STRATEGY (WCS) FOR NORTH TIPPERARY (2009)

The study follows methodologies outlined in government policy on renewable energy, specifically the DoEHLG Wind Energy Guidelines for planning authorities (2006) together with good practice guidance published by the Landscape Institute of the United Kingdom and methodologies used in similar case studies conducted in Scotland. The Strategy is founded on the findings of the baseline Landscape Character Assessment undertaken for the County by Environmental Resources Management (Ireland) Ltd.

The Strategy considered the potential effects of windfarm developments on both landscape character and visual amenity and is focused on two objectives as follows:

- Assessment of the relative suitability of North Tipperary landscapes to wind farm development.
- Provision of design guidance in terms of wind farm layout in respect of the particular landscape character types encountered in the study.

The assessment process was conducted in three steps and included a desk study, fieldwork and reporting as detailed below.

5.4.1.1 Desk Study

The desk studies included

- Data review - a review of both wind farm capacity studies undertaken in Ireland and Scotland and best practice guidance on the subject, specifically the Wind Energy Guidelines (2006) issued by the Department of the Environment, Heritage and Local Government

- GIS Mapping - A wind resource map was prepared for the County GIS and Ordnance Survey mapping for the County at a scale of 1:50,000 and wind speed data sourced from the Wind Atlas 2003 for Ireland prepared by Sustainable Energy Ireland.

- Landscape Character Assessment of North Tipperary -this was prepared in 2004 to form the basis for assessment and classification of the landscape in order to inform policy formulation and decision-making regarding landscape management in the County. The Landscape Character Assessment which identifies and subdivides the County into landscape character areas, with further subdivisions as landscape character types, is the basis for the wind farm strategy.

  In the Wind Capacity Strategy (WCS) the Landscape Character Assessment is augmented by further subdividing landscape character types to reflect variations in landscape characteristics that were considered relevant to the WCS. Wind speeds, where these exceed 7m/s in locations within each landscape character area are also recorded. The area relevant to the Upperchurch windfarm application is identified as Landscape Character Area Upperchurch – Kilcommon Hills comprising Landscape Character Type 6. Farmed Foothills and 16. Enclosed Valley where windspeeds of between 7m/sec and 10m/sec exist.

The WCS states that in general, the southern end of the County has greater wind speed and therefore greater capacity to facilitate wind farm proposals.

- Wind farm capacity assessment –

(a) *Suitability of landscapes to wind farm developments* - From the methodologies studied, a series of 10 No. landscape and 3 No. visual criteria were selected to represent the landscape characteristics most likely to be affected by wind farm developments. These criteria were used to evaluate the relative suitability of the receiving landscapes. The landscape characteristics identify the better locations for wind farms and in this regard, landscapes with a higher potential to accommodate windfarms (less sensitive) in respect to any one of the 10 criteria are scored as 1 whilst areas with a lower potential (more sensitive) to accommodate windfarms under a given criterion are scored as 0. Similarly criteria that relate to visual characteristics that would help to identify the landscapes that would be more visually sensitive to wind farms. A score of 1 applies to a landscape that has a higher capacity to accommodate windfarms based on a given visual criterion and a score of 0 applies in respect of a landscape which has a lower potential to accommodate windfarms.

- Wind farm capacity assessment –

(b) *Design Guidance*–The Wind Capacity Strategy (WCS) takes account of the Wind Energy Planning Guidelines issued by the Department of the Environment, Heritage and Local Government. The WCS states that the design criteria listed in the Guidelines for 6 No. landscape types are applied to the landscapes of North Tipperary and, in general, the county is judged to have 'areas with higher potential' for wind farm development.

5.4.1.2 Fieldwork

A field study was undertaken for the purpose of applying the landscape and visual criteria identified above to the landscape character types identified in each of the Landscape Character Areas (LCA's) of North Tipperary. Within each LCA, the landscape character types that featured appropriate wind resource were studied and scored accordingly.

5.4.1.3 Reporting

The findings of the wind farm capacity strategy are presented for each Landscape Character Area and the Landscape Character Types contained therein for which, viable wind speeds are recorded. The viable areas are evaluated each in turn.

Upperchurch Windfarm is proposed for the Farmed Foothills of the Upperchurch/ Kilcommon Hills area. The windfarm is identified on **Figure 5-3: Wind Capacity Strategy Map (from Figure A1 from the WCS)** at the end of this Chapter. The area is among the highest scoring (a score of 11) landscapes for the accommodation of wind energy developments in the Wind Capacity Strategy (WCS) for North Tipperary.

Upperchurch Kilcommon Hill LCA (Table 1.5 WCS) with LCT 6. Farmed Foothills attracts a score of 8 out of a possible 10 in the 10 No. landscape criteria for suitability for wind farms and 3 out of a possible 3 within 3 No. visual criteria for suitability for wind farms.

The landscape area and landscape type score 1 (indicating suitability) for the following –

Landscape criteria:

- Large in scale and open, regular undulating landform within an anthropogenic landscape containing masts, pylons, buildings, infrastructure, settlements and a regional road. The area is windswept and dynamic with activity and human induced noise

Visual criteria:

- Absence of prominent distinctive peaks and ridges. Absence of topographic features that define the setting, backdrop, main outlook or horizon of areas with extensive population. The area does not constitute an important skyline from a main transport corridor.

The following is the Strategy assessment for the Upperchurch Kilcommon Hills area:

> *The farmed foothills in this landscape are very similar to those encountered in the Silvermines Character Area, In this regard, the capacity to absorb windfarm development is extensive and as previously discussed, some care is required in terms of achieving the right scale of development to match the scale of the receiving*

landscape. The design layout would broadly follow that prescribed for hilly and flat farmland according to the DoEHLG draft guidelines 2004. Some modification will be required to this design solution and that relates to the size of the development. An increase in scale will result in a more successful layout that will respond to this landscape pattern which is bigger in scale than that found in the farmed ridges.

The Upperchurch windfarm proposal is in accordance with the above recommendations. The proposal follows the design guidance of the DoEHLG Guidelines as detailed in the following Chapter of this EIS.

5.4.2. *Outline Landscape Strategy for North Tipperary*

Outline guidance in respect of particular development types is presented in the context of the twelve Landscape Character Areas defined for the County in Section Two (Outline Landscape Capacity). The development types which are the subject of this assessment include the following:

- Commercial Forestry
- Housing in rural areas
- Telecommunications masts

and so do not relate to the proposed development of a windfarm in North Tipperary.

5.5. CONCLUSION

This Chapter examines the proposal for a windfarm at Upperchurch in the context of the North Tipperary County Development Plan 2010-2016, the Landscape Character Assessment and the Wind Capacity Strategy and Landscape Strategy for North Tipperary 2009.

An EIA was conducted and the assessment is described in this Environmental Impact Statement (EIS). An Appropriate Assessment and accompanying Natura Impact Statement was conducted to assess any impact on designated sites in the vicinity of the proposal.
The subject site is in LCA 7: Upperchurch/Kilcommon Hills as illustrated on Figure 8 of the Landscape Character Assessment and the area is identified as having the capacity to accommodate development without undue deterioration in the scenic quality due to the nature of the varying topography of the area.

The proposal is compatible with the North Tipperary County Development Plan 2010-2016 in the context of policy on renewable energy development, design guidelines for windfarms and landscape management policy.

FIGURE 5-1: LANDSCAPE CHARACTER TYPE OF PROPOSED WINDFARM SITE

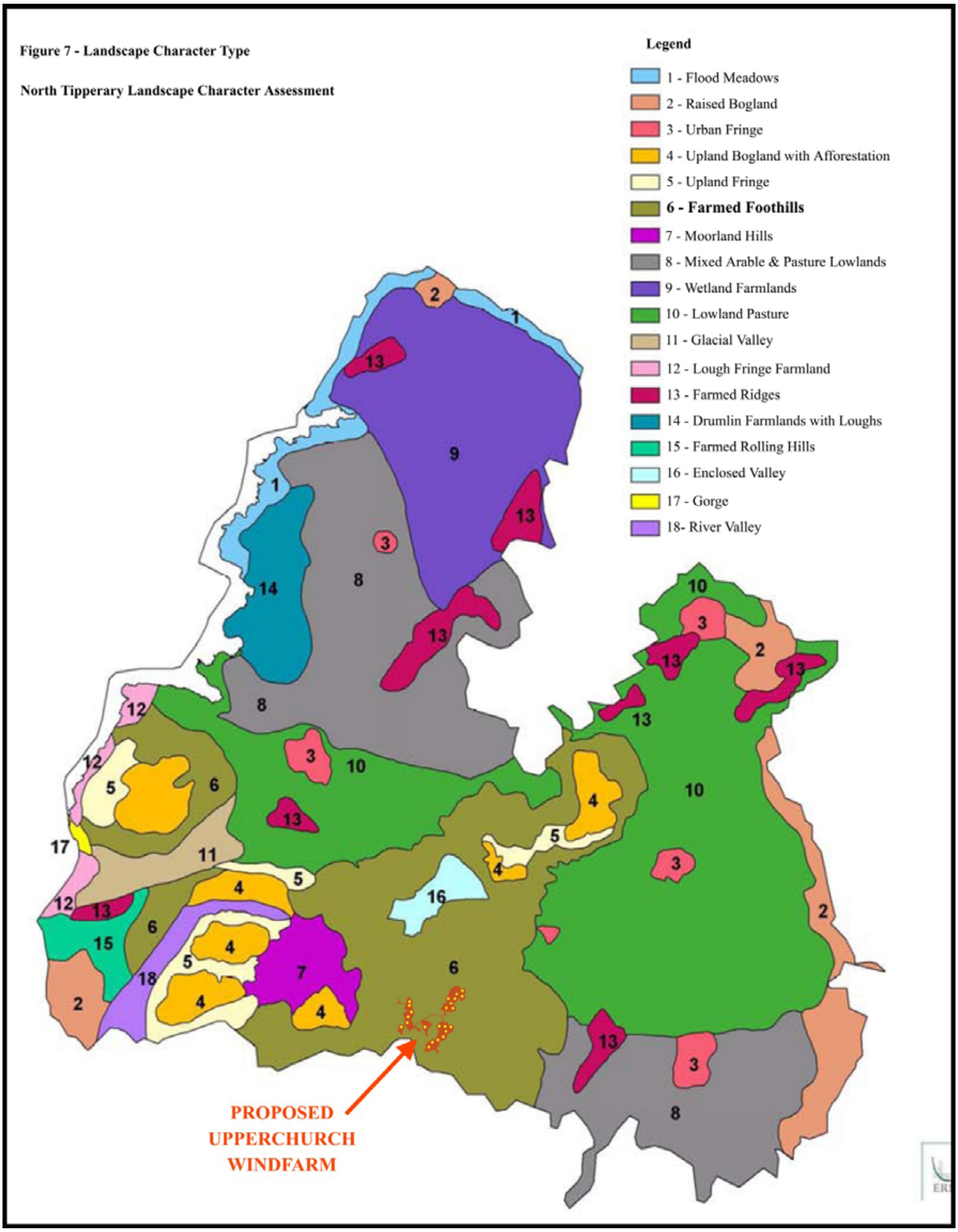
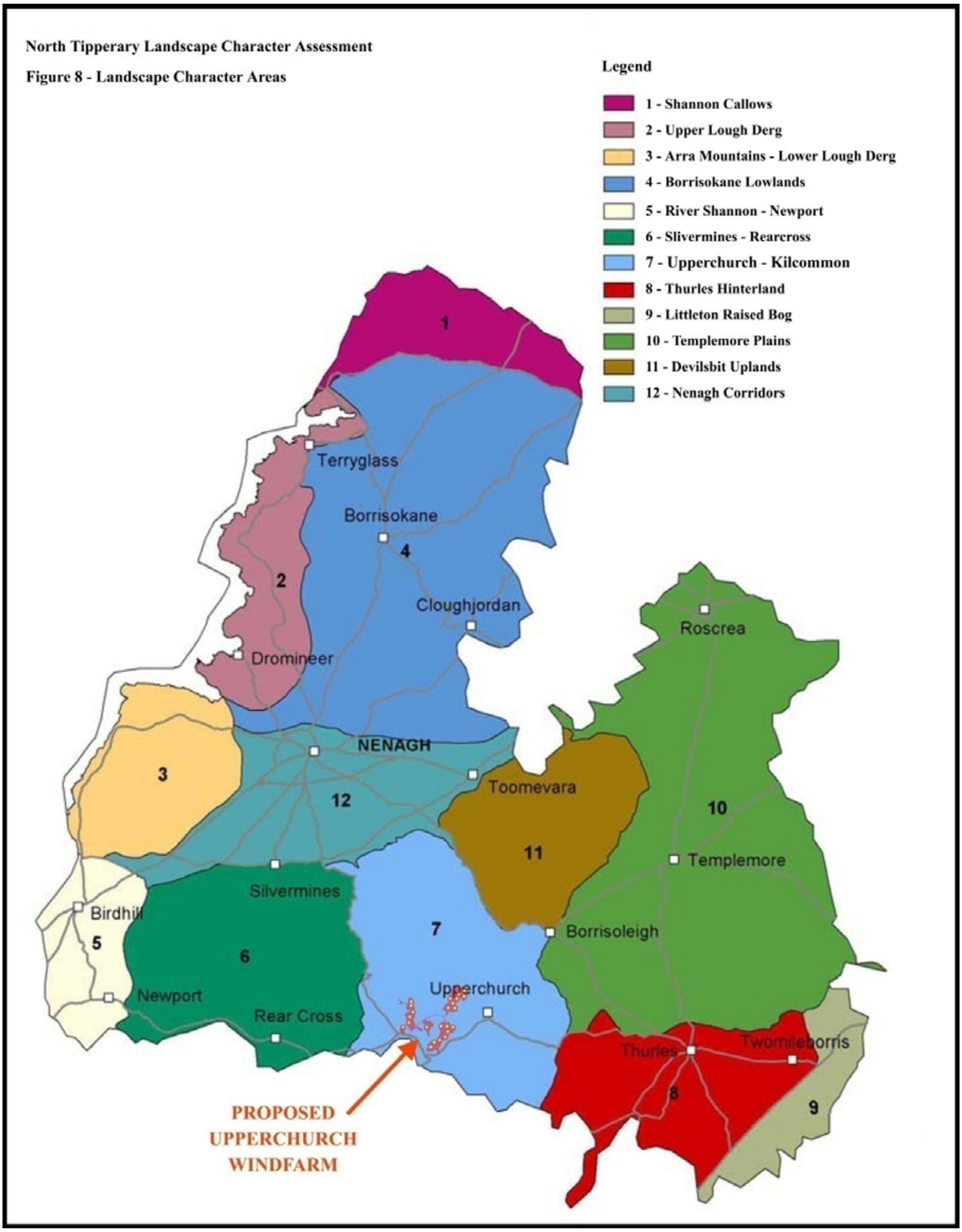
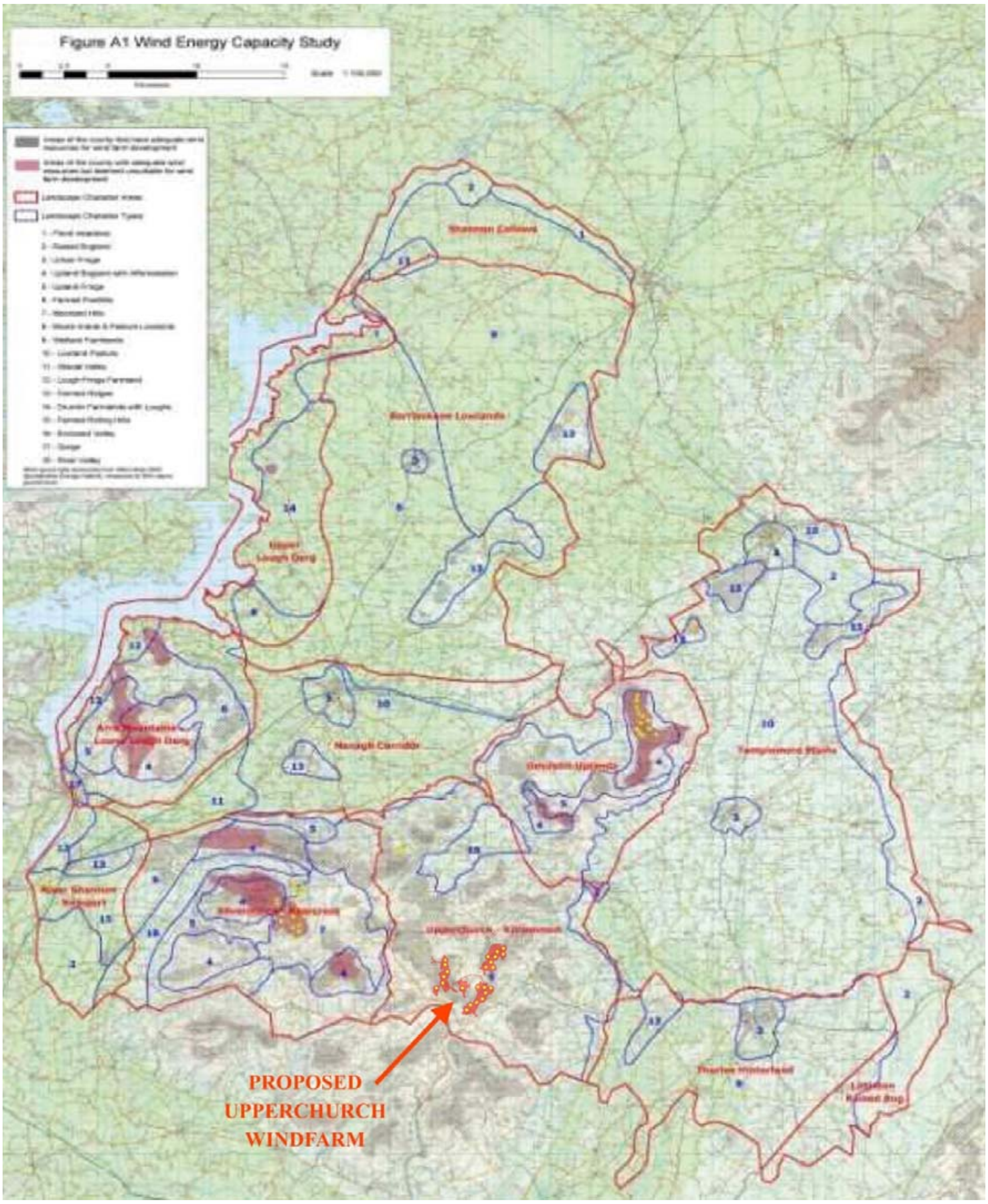


FIGURE 5-2: LANDSCAPE CHARACTER AREA OF PROPOSED WINDFARM SITE



Upperchurch Windfarm Environmental Impact Statement

FIGURE 5-3: WIND CAPACITY STRATEGY MAP (FIGURE A1 FROM THE WCS)



6. Wind Farm Planning Guidelines

The Department of the Environment, Heritage and Local Government (DoEHLG) issued their 1st set of Guidelines to the planning authorities, on wind energy development, in September 1996. Revised Guidelines issued in draft in August 2004 updated and revised, where necessary, the advice given in the 1996 Guidelines. These Guidelines were formally adopted, with modifications, in June 2006.

6.1. CHAPTER 1: INTRODUCTION AND POLICY CONTEXT

The Guidelines state that the development and increasing penetration of renewable energy sources is a priority, nationally and at European level, for both environmental and energy policy grounds. The Policy context for the 2006 Guidelines is:-

- The National Development Plan (2000-2006)
- Sustainable Development: A Strategy for Ireland (1997)
- EU White paper on Renewable Energy (November 1997)
- Green Paper on Sustainable Energy (September 1999) – as reviewed in 2006
- The Electricity Regulation Act 1999
- National Climate Change Strategy (2000)
- Habitat & Birds Directive
- Convention on Biological Diversity and National Biodiversity Plan (2002)
- Making Ireland's Development Sustainable (2002)

A review of options for future renewable energy policy targets and programmes is detailed in the recently published Green Paper on Energy published by the Department of Communications, Marine and Natural Resources in October 2006. The Green Paper commits to a policy of 15% of electricity from renewable sources (mainly wind) by 2010; this target has been achieved and further commitments to implement policies to facilitate the target of 40% of electricity from renewables by 2020 have been made by successive Ministers.

6.2. CHAPTER 2: TECHNOLOGY AND WIND ENERGY DEVELOPMENT

Wind Energy Guidelines Recommendation

Chapter 2 discusses the typical turbines, both size and type, that are in commercial use at present. Details of the typical wind farm are also included. It is stated that technical factors may influence the size of a development, including the physical nature of the site, the wind resource and the capacity of the local electricity transmission or distribution grid as well as landscape and heritage considerations and Development Plan policies.

Upperchurch Windfarm Proposal The design of the proposed Upperchurch windfarm has been influenced by the wind resource present on site, by local residential, natural and built heritage, by the visual amenity/impact and by available grid capacity.

6.3. CHAPTER 3: WIND ENERGY AND THE DEVELOPMENT PLAN

Recommendations are made for turbine developments which might be proposed in designated amenity areas and these are listed under the following headings;-

6.3.1. *Natural and built heritage, amenities and wind energy development*

The designation of an area for protection of natural or built heritage or as an amenity area does not preclude wind farm development.

Upperchurch Windfarm Proposal- The subject site at Upperchurch has no specific natural or built heritage designations. The site is within 2 areas which are identified in the County Designations Map of the County Development Plan 2010 -2016 (CDP) – 1. Upperchurch and 2. Kilcommon Upper. Neither of these areas are zoned Amenity in the Designations Map.

Both the Upperchurch area and Kilcommon Upper area are zoned A1 – Special Landscape Zone and D – Structurally weak. These are zones for which there are specific Housing policies. Policy HSG9 applies to Special Landscape Zones and HSG10 applies to Structurally Weak zones. This zoning is not relevant to the subject application.

6.3.2. *Amenity Designations*

The windfarm will be visible intermittently from Views and Prospects as designated in Appendix 5: List of Protected Views of the County Development Plan. Policy for Views and Prospects is stated in Chapter 4: Environment - Section 4.2.2 Preserving Important Views;

Policy ENV 4: Views and Prospects

> *It is the policy of the Council to protect views and prospects of special amenity value or special interest, as set out in Appendices and the Designations map.*

Upperchurch Windfarm Proposal; the significance of the visibility of the proposal from Views and Prospects as designated is assessed by Mozart Landscape Architects in the Visual Assessment Chapter 11 and sample prospects that offer a view of the proposal are illustrated in the Photomontages in the Visual Impact Assessment chapter also.

Tourism and Recreation

Wind energy developments are not incompatible with tourism and leisure interest, but care needs to be taken to ensure that insensitively sited wind energy developments do not impact negatively on tourism potential. The results of survey work indicates that both tourism and wind energy can co-exist happily.*

**Attitudes towards the Development of Wind Farms in Ireland- (Lansdowne Market Research) Sustainable Energy Ireland, 2003.*

Upperchurch Windfarm Proposal – A further survey on tourist's attitudes to wind farms has been conducted since the SEI survey in 2003. In Aug/Sept 2007 Lansdowne Market Research conducted face to face interviews with tourists in tourism information offices both

North and South as the basis of a presentation for Fáilte Ireland and the Northern Ireland Tourist Board entitled 'Impact of Windfarms on Island of Ireland Tourism'. The scope of the research was to assess tourists' opinions as to whether or not development of wind farms would spoil their enjoyment of the Irish scenery. The responses reflect every opinion on wind energy developments held in the resident/ non-visitor population and can be summarised that although most visitors are broadly positive towards the idea of building more wind farms on the island of Ireland, there exists a minority who are negative towards wind farms in any context (one in seven). However, the great majority felt that wind farms either positively impact on sightseeing or have no impact. The numbers claiming a positive impact on the landscape due to the wind farms are greater than those claiming a negative impact. More than two thirds claim that potentially greater numbers of wind farms would either have no impact on their likelihood to visit or have a strong or fairly strong positive impact on future visits to the Island of Ireland. Those who are negatively disposed are more likely to cite that wind farms look ugly, are noisy and can frighten or damage wildlife. A small number also claim they have preference for other forms of renewable energy. Of those who feel that potentially greater number of wind farms would positively impact on their likelihood to visit, the key driver is their support for renewable energy and potential decreased carbon foot print emissions.

The proposal will not be at variance with the Specific Objectives in the CDP and specifically those stated in Chapter 6: Tourism, Section 6.11.4– E2 to E19.

6.4. CHAPTER 4: RECOMMENDATIONS FOR THE PLANNING APPLICATION

6.4.1. *Pre-application consultation*

Wind Energy Guidelines Recommendation

Pre planning discussions between the developer and the planning authority are recommended.

Upperchurch Windfarm Proposal - Pat Brett of Ecopower Developments met Fergus Wright, North Tipperary County Council on 5th March, 2012 (PPC/4495) to discuss a proposed windfarm development at Knocknamena, Shevry, Knockmaroe and Foilnamon. Recommendations from the meeting were that;

1. Reference should be made to CPD Policies and standards in respect to windfarm developments, the County Landscape Character Assessment as well as the Wind Capacity Strategy.

   The proposal is assessed in the context of the above North Tipperary policy documents in the preceding chapter of this EIS – Chapter 5. Specifically CDP policies and standards are dealt with at Section 5.1 to 5.2. The County Landscape Character Assessment is examined in Section 5.3. The Wind Capacity Strategy is assessed in Section 5.4.

2. An EIS is required. This document comprises the written statement of the Environmental Impact Assessment for the Upperchurch Windfarm proposal

3. It is recommended that a Natura Impact Statement should be submitted given the proximity of the site to the adjoining SPA to the west.

   An Screening for Appropriate Assessment has been undertaken to determine the potential for significant impacts of the proposal on nearby Natura 2000 Sites. This screening and subsequent Appropriate Assessment has been undertaken by Malachy Walsh and Partners ecologists. Stage 2 of the Appropriate Assessment process comprises the Natura Impact Statement and is found in Chapter 13 **Appendix 13-II** of this EIS.

4. It is recommended that the visual impact assessment takes into account the cumulative impact of other windfarms in the area (existing and permitted, including those in Co. Limerick) on the landscape. The visual impact assessment comprising Chapter 11 and undertaken by Mozart Landscape Architects contains written assessment and photomontage illustrations of the cumulative effects of existing and permitted windfarms in South Tipperary immediately to the south, in County Limerick to the south west and North Tipperary to the north west. There are no windfarms either existing or permitted to the east.
5. Haul routes for construction traffic are detailed, as requested, in Chapter 7 of this EIS.

A copy of the consultation document PPC/4495 is found as **Appendix 6-I** at the end of this Chapter.

6.4.2. *Access to the Electricity Grid*

<u>Wind Energy Guidelines Recommendation</u>

It is recommended in the Guidelines that

Details of indicative and feasible options for grid interconnection lines and facilities should in general be adequate for a planning authority to consider the wind farm application as the precise capacity required for connection will not be known until planning permission is obtained. Suggested content for these indicative options might include (a) general direction of connection, (b) connecting line capacity (e.g. 38 kV, 110kV) and (c) line supporting structure (e.g. single pole, twin pole, lattice towers).

<u>Upperchurch Windfarm Proposal</u> –Ecopower Developments Ltd applied for a grid connection for a windfarm in the area in 2004. A Grid Connection Offer for the area, in the Gate 3 Grid Connection Process, was issued to Ecopower Developments by ESB Networks in 2011.

Under grid connection rules, which are determined by the Commission of Energy Regulation (CER), a particular Grid Connection must connect to a defined node on the National Grid but the specific location of the generation plant/windfarm is more flexible.

Under the Grid Connection Offer (Agreement Number: 6002910592 Gate 3 Ref. DG96) it is proposed to connect this windfarm to the National Grid at a point along the Killonan to Nenagh 110kV Transmission line. The point of connection and method of construction of the connection line will be determined by E.S.B. Networks and will be either fully cabled underground or will be a combination of underground cable and overhead line.

6.4.3. *Public consultation with the local community*

<u>Wind Energy Guidelines Recommendation</u>

The guidelines recommend *the developer engage in public consultation with the local community.*

Upperchurch Windfarm Proposal - The developer has agreement with the 37 landowners, 35 of whom live locally and in the main, adjacent to the wind farm. An Information Day was held in the Upperchurch Community hall on 12 December 2012 where proposed site layouts, sound maps, shadow flicker maps and photomontages were presented for examination and discussion. Ecopower Developments staff was available to answer any questions on the project. The walks that have been developed in the area were also discussed and ideas were shared on how the windfarm infrastructure can be used to enhance the walks. An annual community payment was also discussed, the details of which will be agreed with the local community development committee.

6.4.4. ***Requirements of the Environmental Impact Assessment***

Wind Energy Guidelines Recommendation

An Environmental Impact Assessment is mandatory for wind energy developments that exceed the following thresholds:

- have more than five turbines, or
- will have a total output greater than 5 megawatts.

Upperchurch Proposal – An EIA was carried out and the written statement of this assessment comprises this EIS.

6.5. CHAPTER 5: ENVIRONMENTAL IMPLICATIONS (CHAPTER 5)

6.5.1. ***Natural, built and geological heritage***

Wind Energy Guidelines Recommendation

It is recommended that the County Development Plan be consulted in relation to the natural, built and geological heritage, particularly those areas statutorily designated or protected because of the potential of wind energy developments, like all developments, to impact on the natural and built environment.

Upperchurch Windfarm Proposal

The subject site is not part of a p.NHA, c.SAC or SPA. It is subject of no national or international habitat designations. A flora, fauna and birds survey was conducted of the proposed site and Chapter 13 comprises a report on this survey wherein likely impacts, of the proposal, on the natural heritage of the area are considered and mitigation measures, where appropriate, are suggested. An Appropriate Assessment was also carried out and the resultant Natura Impact Statement is contained in Appendix 13-II of **Chapter 13 Ecological Impact Assessment.**

6.5.2. ***Built Heritage – Archaeology***

Wind Energy Guidelines Recommendation

It is recommended that the potential impact of the proposal on the archaeological heritage of the site should be accessed through desk study or field inspection where necessary and that the potential impact of the proposed wind energy development on the architectural heritage of the locality and its landscape context and in particular any nearby structures included on the Register of Protected Structures (RPS) be assessed.

Upperchurch Windfarm Proposal

An archaeological assessment was conducted, including a desk study and field visit, in order to identify the nature and extent of any archaeological remains, the potential direct impact on archaeological features and structures and the potential indirect impact on the archaeological landscape, and on the integrity and visual amenity of existing archaeological monuments in their settings. The architectural heritage of the locality and its landscape context and in particular any nearby structures included on the Register of Protected Structures (RPS) was also studied. The full text of this study is contained in Cultural Heritage Chapter 12.

In summary the proposed turbines will not impact on any identified above ground archaeology. Mitigation proposals are presented which will allow any sub-surface archaeological remains discovered during the civil construction phase to be dealt with appropriately. Archaeological monitoring during excavations for the proposed development will be undertaken by a suitably qualified archaeologist.

6.5.3. ***Geology***

Wind Energy Guidelines Recommendation

It is recommended that a geological assessment of the locality and the bedrock and overburden be conducted. This should include a slope stability assessment and an assessment of any potential impacts of the development on groundwater, any nearby geological NHAs or any on-site mineral or aggregate potential.

It is recommended that provision be made for site-specific geo-technical investigations in order to identify the optimum location for each turbine and that a degree of flexibility for the as-built position of the turbines, of up to 20m, be built into the planning permission and EIS. All surveys should be conducted by a suitably qualified geotechnical engineer and where appropriate hydro-geologist.

Upperchurch Windfarm Proposal

Geotechnical surveys of the site was carried by Malachy Walsh, consultant engineers. These surveys identified geological and soil features, peat extent and depth, geomorphological features, relict failures, rock exposures, wet ground, general soil and rock types and drainage patterns. Trial pits were excavated at 20 of the proposed turbine sites and peat depth and classification was measured at the remaining three sites which are in forested areas. Ground surface slope was measured at all turbine sites. These surveys did not reveal any stress indicators in the form of erosion and the information from the trial pits indicates that the ground is inherently stable and there is no particular risk of failure. All site excavations and construction will be supervised by a suitably qualified engineer. The contractor’s method statement will be reviewed and approved by a suitably qualified geotechnical engineer prior to site operations.

Any potential impacts on ground water were also assessed, by Malachy Walsh, during the hydrological and hydrogeological assessment; the results of this assessment are contained in Chapter 15 Hydrological Impact Assessment. The GSI and EPA databases were consulted. The existing hydrological characteristics at the proposed wind farm site are described, including the surface water features and characteristics, as well as the site drainage and groundwater. An impact assessment was carried out to determine whether the proposal poses a significant impact to the hydrology and hydrogeological aspects of the environment and to propose mitigation measures to reduce any potential negative impact of the proposal. The consultants conclude that the proposed windfarm will not have a significant impact on Hydrology and Hydrogeology provided mitigation measures, as detailed, are implemented.

6.5.4. ***Noise***

Wind Energy Guidelines Recommendation

The nature of the noise which emanates from a working turbine is discussed in this section. It is recognised that advances in turbine technology and design have resulted in reduced noise emissions and that sound output from modern turbines can be regulated. It is recognised that turbine noise increases as wind speeds increase, but at a slower rate than wind generated background noise increases. The impact of wind energy development noise is therefore likely to be greater at low wind speeds when the difference between noise of the wind energy development and the background noise is likely to be greater. At higher wind speeds noise from wind has the effect of largely masking wind turbine noise.

It is recommended that noise impact should be assessed by reference to the nature and character of noise sensitive locations and should include any occupied dwelling house. In general, a lower fixed limit of 45 dB(A)10 or a maximum increase of 5dB(A) above background noise at nearby noise sensitive locations is considered appropriate to provide protection to wind energy development neighbours. However, in very quiet areas, the use of a margin of 5dB(A) above background noise at nearby noise sensitive properties is not necessary to offer a reasonable degree of protection and may unduly restrict wind energy developments which should be recognised as having wider national and global benefits. Instead, in low noise environments where background noise is less than 30 dB(A), it is recommended that the daytime level of noise be limited to an absolute level within the range of 35-40 dB(A). Separate noise limits should apply for day-time and for night time. During the night the protection of external amenity becomes less important and the emphasis should be on preventing sleep disturbance. A fixed limit of 43dB(A) will protect sleep inside properties during the night.

Upperchurch Windfarm Proposal

Malachy Walsh, engineering and environmental consultants, assessed the predicted noise impact from the proposed windfarm using extended measurements of the existing background noise levels (across a range of wind speeds) at nearby representative dwellings and comparisons against the predicted noise output from the proposal, which will also vary with wind speed.

The predicted noise levels present at the nearest dwellings in the worst case scenario i.e. when the turbines are operating in wind speeds of 7-8m/s (approx. 16mph) and when the wind is blowing from the turbines towards the houses are used for this calculation. The Noise Impact Assessment comprises **Appendix 10-I** of Chapter 10.

The assessment has been carried out in accordance with methodology described in ETSU-R-97, Assessment and Rating of Noise from Wind Farms. The results show that the predicted wind farm noise levels adhere to the assessment criteria and in particular the DoEHLG Wind Farm Planning Guidelines.

6.5.5. ***Safety Aspects***

Wind Energy Guidelines Recommendation

The guidelines recognise that there are no specific safety considerations in relation to the operation of wind turbines.

Upperchurch Windfarm Proposal

The Health and Safety aspects of the proposed windfarm are assessed in Chapter 7 Section 7.6 Health & Safety.

6.5.6. ***Proximity to Roads and Railways***

Wind Energy Guidelines Recommendation

It is considered that over time the turbines become part of the landscape and in general do not cause any significant distraction to motorists.

6.5.7. ***Proximity to power lines***

Wind Energy Guidelines Recommendation

Adequate clearance between structures and overhead power lines as specified by the electricity undertaker should be provided.

Upperchurch Windfarm Proposal

No structures proposed for this site are located beneath existing power lines. See exclusion table in NTCDP Chapter 5.

6.5.8. ***Interference with Communication Systems***

Wind Energy Guidelines Recommendation

Wind turbines, like all electrical equipment, produce electro -magnetic radiation and this can interfere with broadcast communications. The interference with broadcast communication can be overcome by the installation of deflectors or repeaters. Planning authorities should advise the developer to contact the individual broadcasters, national and local and advise them of the proposals……. Mobile phone operators should also be advised to the proposed development.

Upperchurch Windfarm Proposal

Ai Bridges, who are a leading supplier of innovative broadband & telecommunication solutions and services for the telecom's industry, were commissioned to assess the interference if any with communication signals in the area. Their report - Upperchurch

Communications Impact Study finds that no licensed or unlicensed microwave radio links will be impacted by the proposed turbines. Vodafone has a GSM service operating from Knockmaroe mast, however turbines do not impact GSM services. Tetra Ireland has confirmed that there will be no impact to the Tetra network. With regard to TV reception, it is recommended that prior to the construction phase a TV modelling report should be conducted and mitigation measures to offset any interference caused by the proposed wind turbines should also be provided.

The Communications Impact Study is attached in **Appendix 6-II** at the end of this chapter.

6.5.9. *Aircraft Safety*

Wind Energy Guidelines Recommendation

The siting of wind turbines may have implications for the operations of the Communications, Navigation and Surveillance systems used for Air Traffic Control. Wind turbine siting may also have implications for the flight paths of aircraft……. Accordingly, wind energy developers should be advised to contact the Irish Aviation Authority at the pre-planning stage of consultation, with details of locations and proposed heights of turbines, to ensure that the proposed development will not cause difficulties with air navigation safety.

See **Appendix 6-III** Email response from IAA at the back of this Chapter.

Upperchurch Windfarm Proposal

The developer contacted the IAA regarding possible interference with their communications signals. They replied that their requirements are

> *an agreed lighting scheme, notification 30 days prior to construction and as built coordinates of the completed development for charting purposes.*

6.5.10. *Shadow Flicker*

Wind Energy Guidelines Recommendation

The phenomenon of Shadow Flicker is explained in this section. It is stated that the effects of flicker only last for short periods and under a particular set of circumstances combined. It is recommended that shadow flicker at neighbouring dwellings within 500m should not exceed 30 hours per year or 30 minutes per day. It is recognised that at distances greater than 10 rotor diameters from a turbine, the potential for shadow flicker is very low. Where shadow flicker could be a problem, developers should provide calculations to quantify the effect and where appropriate take measures to prevent or ameliorate the potential effect, such as by turning off a particular turbine at certain times.

Upperchurch Windfarm Proposal

The predicted shadow flicker effect on the nearest occupied dwellings was modelled and the full results are detailed in Residential Amenity Chapter 10. In summary the Wind Energy Guidelines recommend that shadow flicker at neighbouring dwellings within 500m should not exceed 30 hours per year. The Guidelines state that at distances greater than 10 rotor diameters from a turbine, the potential for shadow flicker is very low. Therefore computer modelling to assess the predicted period of shadow flicker effect inside houses within 900m of a proposed turbine was carried out. The module which was used allows for the creation of a 'shadow flicker effect at specified sensitive receptors' occurrence map. The scope of the model was to access the cumulative effect of the proposed turbines on any receptor (i.e. dwelling) within 900m of the nearest turbine. There are 93 houses within 900m of a proposed turbine. The model, which predicts a 'worst case' scenario, shows that 4 houses within 500m and 2 other houses outside of 500m, exceed the Guidelines recommendation by between 7 to 22 hours per annum. However, predicted durations will apply only if there is a coincidence of the sun shining at a very low angle, the property has a window facing the turbine and there are no intervening trees and the turbine blades are moving. In other words shadow flicker can only occur if the sun is shining and when the sun is low in the sky and if the wind is blowing and the turbine blades can be seen from the house.

Met Eireann data shows that the sun shines for 29% - 40% of the time in Ireland and therefore in reality all the houses will only experience shadow flicker for less than half of the time that the model has predicted.

Ecopower Developments intend, for the first two years of operation, to log in real time the actual shadow flicker duration at the six dwellings mentioned above to ensure that the effect will not exceed 30 hours per annum. In the unlikely event that it is found that the 30 hours per annum limit will be exceeded, the offending turbine will be shut down during the time that it would cause the effect at the particular dwelling in question for the remaining part of that year.

6.5.11. ***Decommissioning and Reinstatement***

Wind Energy Guidelines Recommendation

It is recommended that the decommissioning of a wind energy development once electricity ceases to be generated must be assessed. Issues to be addressed include restorative measures, the removal of above ground structures and equipment, landscaping and/or covering with topsoil and reseeding.

Upperchurch Windfarm Proposal

The decommissioning and reinstatement of the proposed wind farm is assessed in Chapter 3 (Section 3.6 Decommissioning).

6.5.12. ***Windtake***

Wind Energy Guidelines Recommendation

It is recommended that *"The question of windtake should be dealt with at scoping stage and/or during pre-application discussions, to ensure that any proposed layout of wind turbines takes into account the development potential of an adjoining site for a similar development"*

And...*"Bearing in mind the requirements for optimal performance, a distance of not less than two rotor blades from adjoining property boundaries will generally be acceptable, unless by written agreement of adjoining landowners to a lesser distance."*.

Upperchurch Windfarm Proposal

The proposed turbines will have a rotor blade of up to 55m and therefore a distance of 110m from adjoining property boundaries is generally acceptable. The County Development Plan recommendation is for 1.5 X turbine height in which case an indicative boundary set back distance is 189m (the application is for turbines of up to 126.6 tip height).

The Guidelines state that a lesser distance is acceptable by written agreement of adjoining landowners.

The proposed turbines are a minimum of 189m from the site boundaries except in the case of T17 which is 60m for a neighbouring boundary.

6.6. CHAPTER 6 OF THE GUIDELINES: AESTHETIC CONSIDERATIONS IN SITING AND DESIGN

The primary purpose of Chapter 6 of the Guidelines is to provide guidance to planning authorities in decision-making in relation to the siting and design of wind energy developments in the landscape when assessing applications for planning permission.

The first section of this chapter deals with the general principle of landscape siting and design of wind farms under the following headings:-

- Siting
- Spatial extent and scale
- Cumulative effect
- Spacing of turbines (regular, irregular, graduated)
- Layout of turbines (single line, staggered line, clustered, grid)
- Height of turbines (tall, medium, short)

The second part (from Section 6.9 Landscape Character Types as a Basis for Guidelines) considers how these principles can be best applied within different types of landscapes.

Six No. landscape character types are identified to provide a basis for the application of the siting and design guidelines, as described in the first part of Chapter 6 (Sections 6.3 - 6.8 of the Guidelines). The six landscape character types, which have been identified, are:-

- Mountain moorland
- Hilly and flat farmland
- Flat peatland
- Transitional marginal land
- Urban / industrial
- Coast

Upperchurch Windfarm Proposal

The proposed site area is within Upperchurch Kilcommon Hills Landscape Character Area (LCA) in the Wind Capacity Strategy and Outline Landscape Strategy for North Tipperary. The site area is in Landscape Character Type (LCT) 6: Farmed Foothills within this LCA. The Strategy states that the design layout for this LCA would broadly follow that prescribed for hilly and flat farmland according to the Wind Energy Guidelines.

The key characteristics of hilly and flat farmland are described in the Guidelines as

- Intensively managed farmland, whether flat, undulating and hilly
- A patchwork of fields delineated by hedgerows varying in size
- Farmsteads and houses are scattered throughout as well as occasional villages and towns
- Roads, telegraph and electrical power lines are significant components
- A working and inhabited landscape type

6.6.1. *Siting and design guidance for hilly and flat farmland (Section 6.9.2of the Guidelines)*

6.6.1.1 Location:

Wind Energy Guidelines Recommendation

Location on ridges and plateaux is preferred, not only to maximise exposure, but also to ensure a reasonable distance from dwellings. Sufficient distance should be maintained from farmsteads, houses and centres of population in order to ensure that wind energy developments do not visually dominate them. Elevated locations are also more likely to achieve optimum aesthetic effect. Turbines perceived as being in close proximity to, or overlapping other landscape elements, such as buildings, roads and power or telegraph poles and lines may result in visual clutter and confusion. While in practice this can be tolerated, in highly sensitive landscapes every attempt should be made to avoid it.

Upperchurch Windfarm Proposal

The turbines are proposed for the more elevated lands on the site to maximise exposure to the available wind regime and to achieve a separation distance from the nearest residences. The turbines are proposed for the elevated areas at Knockmaroe to the west, Grousehall to the north-west, Knocknamena to the north-east and Shevry to the east. Roads, power-lines and houses are generally in the more low lying lands throughout this area. The proposed siting of turbines on the elevated lands will result in the total project being viewed as separate from other landscape elements.

6.6.1.2 Spatial extent:

Wind Energy Guidelines Recommendation

Spatial extent: This can be expected to be quite limited in response to the scale of fields and such topographic features as hills and knolls. Sufficient distance from buildings, most likely *to be critical at lower elevations, must be established in order to avoid dominance by the windfarm.*

Upperchurch Windfarm Proposal

The design of the proposed wind farm is in general accordance with all of the design criteria outlined in the Guidelines except that relating to spatial extent. However, in this instance there is clear direction from the North Tipperary County Development Plan that a broader extent of development will be sought in this landscape character area than is provided for in the guidelines for 'Hilly and Flat Farmland'. Furthermore, the fact that the development is relatively dispersed across four elevated areas reduces its intensity, particularly at local receptors where views of discreet clusters of turbines are more commonplace than of the full scheme.

6.6.1.3 Spacing:

Wind Energy Guidelines Recommendation

The optimum spacing pattern is likely to be regular, responding to the underlying field pattern. The fields comprising the site might provide the structure for spacing of turbines. However, this may not always be the case and a balance will have to be struck between adequate spacing to achieve operability and a correspondence to field pattern.

Upperchurch Windfarm Proposal

The turbines are spaced in response to the underlying field patterns which are irregular and undulating and provide the structure for spacing of turbines which must be positioned a minimum separation distance from other turbines, site boundaries and neighbouring residences.

6.6.1.4 Layout:

Wind Energy Guidelines Recommendation

The optimum layout is linear and staggered linear on ridges (which are elongated) and hilltops (which are peaked) but a clustered layout would also be appropriate on a hilltop. Where a wind farm is functionally possible on a flat landscape a grid layout would be aesthetically acceptable.

Upperchurch Windfarm Proposal

It is proposed to position the turbines in clusters on the elevated areas to the west, north-west, north-east and east of the site.

6.6.1.5 Height:

Wind Energy Guidelines Recommendation

Turbines should relate in terms of scale to landscape elements and will therefore tend not to be tall. However, an exception to this would be where they are on a high ridge or hilltop of *relatively large scale. The more undulating the topography the greater the acceptability of an uneven profile, provided it does not result in significant visual confusion and conflict.*

Upperchurch Windfarm Proposal

The proposal is for tall turbines, similar in size to turbines already constructed and permitted in the area, on a series of hills and ridges of relatively large scale comprising complex undulating topography which has a high visual absorption capacity.

6.6.1.6 *Cumulative Effect:*

Wind Energy Guidelines Recommendation

It is important that wind farm development is never perceived to visually dominate. However, given that these landscapes comprise hedgerows and often hills and that views across the landscape will likely be intermittent and partially obscured, visibility of two or more wind farms is usually acceptable.

Upperchurch Windfarm Proposal

The wind farm will be intervisible, to a greater or lesser extent depending on vegetation and undulating topography when travelling through the area, with other planned and permitted wind farms in particular to the south around Hollyford in South Tipperary and to the west at Knockastanna in Co. Limerick.

The cumulative visual impact of the proposed turbines in addition to the permitted and existing wind farms in South Tipperary and East Limerick is illustrated in all of the photomontages in the Landscape and Visual Assessment Chapter 11.

6.6.2. *Summary of Siting and design guidelines*

Table 1: Matrix Summarising Landscape Character Based Recommendations

	Location	Spatial Extent	Cumulative Effect	Spacing	Layout	Height
Hills and Flat Farmland	Anywhere	Generally limited to small wind farms	Acceptable depending on appropriate siting and design	Regular	Linear and staggered linear on ridges and clustered on hilltops	Medium typically preferred but tall acceptable

Wind Energy Guidelines Recommendation

It is stated in North Tipperary Wind Capacity Strategy that the proposed site corresponds to the landscape description for Hilly and Flat Farmland in the Guidelines. The siting and design guidelines for this landscape type (summarised in Table 1 above from the Guidelines) are for the location of a wind farm, limited in spatial extent, on ridges and plateaux, above houses and other infrastructural developments. The turbines should be regularly spaced and positioned in a staggered linear layout on ridges and clustered on hilltops. Tall turbines are accepted on high ridges and hilltops of large scale and where the topography is complex and undulating. Given that these landscapes comprise hedgerows and often hills and that views across the landscape will likely be intermittent and partially obscured, visibility of two or more wind farms is usually acceptable.

Upperchurch Windfarm Proposal

It is proposed to construct a large wind farm in clusters on elevated sites above houses and infrastructure in the Upperchurch area and the siting and design of the proposal is compatible with the Wind Energy Guidelines. A wind farm of large scale is recommended for this area in the North Tipperary Wind Capacity Strategy. Tall turbines are proposed which will reflect the scale of the receiving landscape and the size of existing turbines. The windfarm will be intervisible when travelling through the area with existing and permitted windfarms to the south. This intervisibility will be intermittent due to roadside vegetation and undulating topography.

6.6.3. ***Landscape impact of wind farm construction***

Wind Energy Guidelines Recommendation

(Section 6.10 of the Guidelines)

The process of construction can result in adverse landscape and visual impact due to, for example, temporary structures and materials on site, alterations to drainage, dust, ground compaction, excavation, road construction, soil erosion and mineral leaching, as well as traffic movement.

Upperchurch Windfarm Proposal

The recommendations for the construction phase, as outlined in Section 6.10 of the Guidelines, will be implemented during the construction of the proposed windfarm. Details of construction mitigation measures are contained in Chapter 37 Construction Impacts, of this EIS.

6.6.4. ***Landscape impact of associated development***

6.6.4.1 Section 6.11 of the Guidelines

Wind Energy Guidelines Recommendation

Guidance is also given in relation to associated development, including substation compounds, access tracks and fencing.

The elements associated with wind farms other than turbines include the roads and tracks, power poles and lines, the control building, the wind measuring mast and compound. Individually and collectively these elements should be considered, located and designed to respect the character of surrounding landscape.

Upperchurch Windfarm Proposal

The character of the surrounding landscape has been considered when deciding the layout of associated development on the windfarm. The sub-station compound is proposed for a low lying area in the centre of the site. All electrical lines between the turbines and the wind farm sub-station will be cabled underground. In total c.12km of site roads are required for the development, however one third these roads will be upgraded from existing farm and forestry tracks.

6.6.4.2 Fencing

Wind Energy Guidelines Recommendation

It is recommended that fencing on site should be limited to the sub-station compound.

Upperchurch Windfarm Proposal

The sub-station compound will be fenced according to ESB regulation. There is no requirement for fencing of turbine areas as access can only be gained to the towers through a steel door which is locked at all times. There will be some agricultural fencing erected on site where required by the landowners and any existing fencing along farm boundaries will be restored.

6.6.4.3 Connection to electricity providers

Wind Energy Guidelines Recommendation

It is recommended that power line connections between turbines and from turbines to the control building should be undergrounded and these lines should be interred alongside wind farm access roads in order to minimise habitat and hydrological disturbance. Above ground connections, carried preferably on wooden poles, from the sub-station compound to the national grid are acceptable in all but the most sensitive landscapes. Where practicable, power lines should not cross the horizon at ridge level unless a line already exists. Where passing through a forest, power line connections should follow existing firebreaks or roads. In landscape types where human presence and rectilinear landscape patterns are typical, power line layout can be more flexible.

Upperchurch Windfarm Proposal

The cabling between the proposed turbines and the windfarm sub-station will be undergrounded and interred alongside access road routes whenever possible. The nature and location of the power line or cable from the sub-station to the National Grid will be subject of a separate planning application.

6.6.4.4 Roads/Tracks

Wind Energy Guidelines Recommendation

It is recommended that the extent of new tracks should be kept to a minimum and existing roads should be utilised where possible. Sensitive areas such as archaeological sites should be avoided as far as possible while important features such as streams should be properly bridged or culverted. Crushed stone, sourced locally, is preferred for the road material. Disturbed soil should be levelled and balanced and reseeded or re-sodded whichever is appropriate.

Upperchurch Windfarm Proposal

In total there will be 11.6km of windfarm roads, 3.6km of these roads will be along existing farm roads and some forestry roads. These roads will be upgraded to facilitate wind farm construction. There will be 8km of new tracks constructed on site. Prior to the layout of the site roads being finalised, an archaeological assessment was carried out on site and areas of archaeological interest were avoided (see Chapter 12 Cultural Heritage **Figure 12-5 to Figure 12-12**). There is one stream crossings required for the windfarm development, in the east of the site. It will be clear spanned or culverted. (see Chapter 15 Hydrological Impact Assessment). There are six borrow pits identified on site which will be used to quarry stone for the construction. If more stone is required it will be sourced locally. (See Chapter 14 – Geotechnical Assessment Section 14.4.1.3).

6.6.4.5 Turbine Colour

Wind Energy Guidelines Recommendation

It is recommended that white, off-white or light grey are the most appropriate turbine colour under Irish visibility conditions. Matt, non-reflective finishes should be used on all turbine components.

Upperchurch Windfarm Proposal

The turbines will be painted off white/ light grey. This colour has been found to be the most satisfactory tone for blending with the predominately cloudy/misty conditions of Irish upland sites. Matt non-reflective paints will be used.

6.6.4.6 Turbine Maintenance

Wind Energy Guidelines Recommendation

It is recommended that rotors should be kept rotating and counter rotation of blade-sets should be avoided. Any malfunctioning turbines should be repaired or removed together with ancillary structures. Nacelles and towers should be kept clean of leakage from internal fluids.

Upperchurch Windfarm Proposal

Counter rotation of blades will be avoided. The nacelle and tower will be cleaned of any leakage of oil or fluids. The turbines will be maintained by fully trained turbine maintenance technicians and will be kept in good working order.

6.6.4.7 Turbine transformers

Wind Energy Guidelines Recommendation

It is noted that turbine transformers are relatively small and their visual impact is localised and therefore turbine transformers can be located either within the tower, partially underground or adjacent to the tower and that decisions regarding the location of transformers should be informed by health and safety criteria.

<u>Upperchurch Windfarm Proposal</u>

The transformers for the turbines planned for the entire windfarm are located within the turbine tower. However if another/newer model is used the location of the transformers will be informed by health and safety criteria.

6.6.5. *Landscape Impact of Wind Farm Operation and Decommissioning*

<u>Wind Energy Guidelines Recommendation</u>

It is recommended that the operability of turbines should be carefully monitored electronically so as to minimise the duration of a static non-functioning blade set, as otherwise visual disharmony could result.

Decommissioning should involve the removal of all of the aboveground elements of the wind energy development and making good of the site, with the possible exception of roads and tracks where some further use can be found for them and this is approved by the planning authority. Foundation pads can be covered with local soil and left for natural re-vegetation.

<u>Upperchurch Windfarm Proposal</u>

The turbines will be monitored remotely on a 24-hour basis and monitored locally by maintenance personnel to ensure that the turbines work as efficiently as possible. A modern wind turbine typically delivers 97% availability i.e. the turbines will be available for production at least 97% of the time. Modern turbines begin to produce electricity at low wind speeds of 3 – 4 m/sec.

In the event of the decommissioning of the wind farm, all the above-ground elements can be removed and the access tracks and foundation pad covered in soil and re-seeded if required. The decommissioning proposals for turbines are contained in Chapter 3 Section 3.6.

6.7. CHAPTER 7 OF THE GUIDELINES: PLANNING CONDITIONS

Chapter 7 presents guidance to the planning authority on matters that may be appropriately dealt with by the inclusion of conditions on a planning permission for wind energy development.

The subject application is examined in the previous Chapter of this EIS in the context of North Tipperary County Development Plan policy on wind energy developments.

6.8. CONCLUSION

The siting, design (both technical and aesthetic) and layout of the proposed Upperchurch windfarm was developed having regard to the Department of Environment, Heritage and Local Government Wind Energy Guidelines (2006).

APPENDIX 6-I: COPY OF PRE-PLANNING MEETING (PPC-4495)

Comhairle Contae Thiobraid Árann Thuaidh

North Tipperary County Council

Telephone (067) 44652
Fax (067) 44654
E-mail planning@northtippcoco.ie

Planning Section
Civic Offices,
Limerick Road, Nenagh,
Co. Tipperary.

Our Reference	Your Reference	Date
PPC/4495		*7th March, 2012*

Re: Pre-Planning Consultation

Proposed development at Knocknamena, Shevry, Knockmaroe & Foilnamon

Dear Sir/Madam,

The Planning Authority is required to keep a written record of consultations in relation to proposed development in accordance with Section 247 of the Planning & Development Act 2000 – 2002.

Attached are details kept in relation to your pre-planning consultation **received on 06/02/2012. Please refer to response on Page 2.**

Your pre-planning Ref No. is **PPC/4495.** If you make a planning application you will require this information to answer Question 18 on the Application Form.

If you have any queries in relation to same, please do not hesitate to contact this office on 067 44655 **(between the hours of 9.30 a.m. and 4.00 p.m.)**

Yours faithfully,

Ann-Marie O'Flaherty

for Director of Services.

Pat Brett,
Ecopower Developments,
Sion Road,
KILKENNY.

North Tipperary County Council
Planning Section

CONSULTATION IN RELATION TO PROPOSED DEVELOPMENT

1. Name: Pat Brett

1a. Name of Land Owner: Ecopower Developments

2. Postal Address Ecopower Developments
Sion Road, Kilkenny

2a. Land Owner's address: Sion Road, Kilkenny

3. Phone: 056-7750140

Mobile: 086-8241542

4. Nature and Extent of Proposed Development:

Windfarm Development

5. Location of proposed development (include Townsland):

Knocknamena, Shevry, Knockmaroe & Foilnamon

6. Details of nature of query:

Pre-planning meeting

7. Current or previous Planning Ref. (if any): none

N.B: Please attach appropriate site location map to a scale of 1:10560 (6":1mile) or relevant extract from 1:50,000 Ordnance Survey and photographs showing the context of the site i.e. adjacent land/buildings and general topography (if rural), and landholding of land owner.

Note: Please complete and return this form to: ***Planning Section, North Tipperary County Council, Civic Offices, Nenagh, Co. Tipperary. 067 – 44652 planning@northtippcoco.ie***

As soon as we receive this completed form, it will be assessed by the relevant Planner to determine the appropriate method of dealing with the consultation query, i.e. by telephone or by written report or by pre-arranged appointment. You will be contacted in the appropriate format as soon as possible. **It is essential that as much information as possible is submitted to enable the consultation to be of benefit to you.**

North Tipperary County Council, pursuant to Section 247 of the Planning and Development Act, 2000, holds consultations with interested parties who may wish to make a planning application for a development in the Council's functional area. North Tipperary County Council as Planning Authority will keep a record of any such consultations, which will be a matter of public record. The carrying out of such consultations shall not prejudice the performance by the Planning Authority of any other of its functions under the above Act, or any Regulations made under the above Act, and cannot be relied upon in the formal planning process or in legal proceedings

8. For Office Use Only:

(a) Will Part V apply Yes ☐ No ☐

(b) Allocated Planner: FW

(c) Dealt with by phone on:

(d) Dealt with by report on

(e) Date of appointment: 5.3.12

(f) Time of appointment: 3.00pm

(g) PPC Ref. No. 4495

PPC/4495

Refer to relevant County Development Plan policies and standards in respect of wind farm development as well as the County Landscape Character Assessment as well as the Wind capacity Strategy

1) An EIS will be required

2) A Natura Impact Statement should be submitted given the proximity of the site to the adjoining SPA to the west.

3) The visual impact assessment will need to take account of the cumulative impacts of other wind farms in the area (existing and permitted including those within Co. Limerick) upon the landscape.

4) Consideration will need to be given to haul routes for construction traffic.

Prior to the submission of a planning application you may wish to submit more details of the project including some photomontages etc as well as summarizing the main issues etc to be covered in the intended EIS and extent of the NIS.

H Wright EP.

06/03/12

Appendix 6-II A

Communications Impact Study with preliminary layout

Report

Appendix 6-II

Upperchurch Wind Farm

Telecommunications Impact Study

Company:	Ai Bridges - Telecommunication Consultants		
Author:	D. McGrath.		
Approved for Release:	Rev 3.0 David McGrath	**Date:**	04/09/12

Document Filename: *Upperchurch Wind Farm Communications Impact Study*

AiBridges Total Broadband Solutions	**Procedure: 001**	**Rev: 3.0**
Title: Upperchurch Communications Impact Study	**Approved: DM**	**Date: 04/09/2012**

AiBridges Total Broadband Solutions

Communications Impact Study with preliminary layout

1. INTRODUCTION

In this report we evaluate the possible effects that the proposed wind farm development at Upperchurch could have on existing communications networks. The requirement was to identify any communications infrastructure that may be impacted by the development through telecom operator consultations and field & desktop studies.

Methodology:

A selection of communications site coordinates obtained during desktop & site surveys, as well as inputs from various operators \ service providers were converted from Irish National grid (Easting and Northing in meters) to degrees minutes seconds format and then imported into a radio planning tool. This provides a means of graphically showing the sites in the vicinity relative to the proposed wind farm. The possible impact to communications infrastructure near the development can then be assessed. Figure 1 below shows that there are 18 communication sites in the vicinity of the Upperchurch development. Following consultations with telecom operators, it was found that only one communications site (Knockmaroe) would be impacted by the wind farm. Communications equipment on the other sites are not impacted by the proposed development.

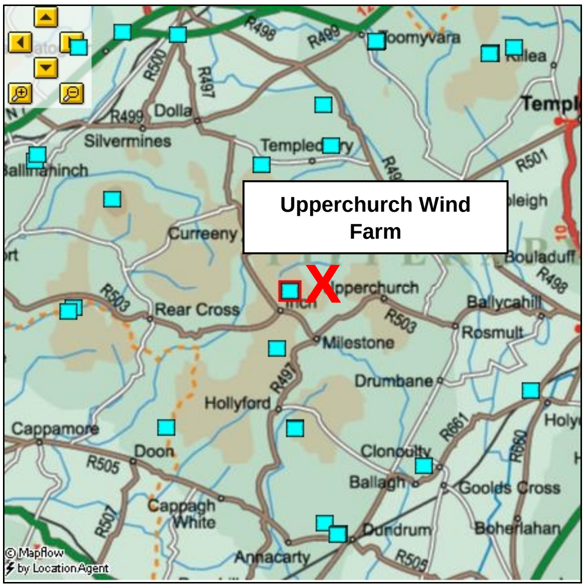


Figure 1. Communication sites in the Upperchurch area.

2. WIND FARM DEVELOPMENT DETAILS

The proposed wind farm development at Upperchurch is located west of the village of Upperchurch in County Tipperary. The report is based on a wind farm proposal consisting of 23 turbines with a maximum hub height of 85 meters and a maximum rotor diameter of 90 meters.

Number of Turbines	Max Hub Height	Max Rotor Radius	Max Tip Height
23	85m	45m	126.6m

Table 1. Upperchurch Wind Farm Turbine Details

The location of Upperchurch wind farm is shown below in Figure 2. The co-ordinates of the proposed turbines are listed in Appendix A.

Figure 2. Location of Upperchurch Wind Farm.

3. TELECOM OPERATOR CONSULTATIONS

To establish if communication infrastructure could be impacted by the proposed wind farm development, consultations with telecom operators in the area were undertaken. Table 2 lists the operators and the relevant departments contacted. The responses received from each of this operator are presented in Section 3.1

Operator	Division / Department
Three Ireland	BT Global (Ireland), Transmission Planning
Eircom	Radio Division
Meteor	Mobile Communications
O2	Telefonica O2 (Ireland), Network Delivery
Tetra Ireland	Tetra Ireland
RTE NL (RTÉ Transmission Network Limited)	RTE Radio Planning
Vodafone	Vodafone Ireland, Team South, Access Engineering
Munster Broadband	Munster Broadband Network Operations

Table 2. Telecom Operators Consulted.

3.1 Telecom Operator Responses

Sections 3.1.1 to 3.1.8 that follow, present the telecom operator responses to consultations regarding their communications infrastructure in the vicinity of the wind farm development at Upperchurch.

3.1.1 Three Ireland Response to Consultations

Three Ireland provided the following email response to consultations:

> *"The turbine that is causing concern for 3 Ireland is UCT9. This is approximately 150m away from the site *TP Foilnaman Tower . Whilst the impact of the proposed location of UCT9 is not ideal, it is not detrimental to the 3 Ireland **RF network.*
>
> *However if the location of UCT9 changes in any way we would like to be consulted on this."*

** Three Ireland refer to the site at Knockmaroe as "TP Foilnaman Tower"*
*** RF network: Radio Frequency network*

3.1.2 Eircom Response to Consultations

Eircom provided the following email response to consultations:

> *"I have checked the proposed turbine layout below and I can confirm that there is no conflict with the eircom microwave network."*

Turbine ID	Easting	Northing
UCT1	194900	158957
UCT2	195136	159283
UCT3	195513	159435
UCT4	195885	159645
UCT5	196409	160330
UCT6	196015	160391
UCT7	196080	160032
UCT8	193386	160635
UCT9	193455	161035
UCT10	193558	162082
UCT11	195614	160417
UCT12	196559	161625
UCT13	196105	161649
UCT14	196409	161953
UCT15	196251	162315
UCT16	196692	162277
UCT17	197203	162448
UCT18	197224	162824
UCT19	196830	162616
UCT20	193023	160374
UCT21	193537	161812
UCT22	194615	160329
UCT23	193671	161365

3.1.3 Meteor Response to Consultations

Meteor provided the following email response to consultations:

> *"I've looked at this proposal (co-ords below) and it will cause no issues for the Meteor *TXN network."*

Turbine ID	Easting	Northing
UCT1	194900	158957
UCT2	195136	159283
UCT3	195513	159435
UCT4	195885	159645
UCT5	196409	160330
UCT6	196015	160391
UCT7	196080	160032
UCT8	193386	160635
UCT9	193455	161035
UCT10	193558	162082
UCT11	195614	160417
UCT12	196559	161625
UCT13	196105	161649
UCT14	196409	161953
UCT15	196251	162315
UCT16	196692	162277
UCT17	197203	162448
UCT18	197224	162824
UCT19	196830	162616
UCT20	193023	160374
UCT21	193537	161812
UCT22	194615	160329
UCT23	193671	161365

** TXN : Transmission Network*

3.1.4 Telefonica O2 Response to Consultations

O2 provided the following email response to consultations:

> *"I'm happy to report that this proposed development will not affect any of our microwave links in the area. Please see attachment with the nearest transmission path marked in green."*

Figure 3. O2 Communication links in the vicinity of the proposed development.

3.1.5 RTE NL Response to Consultations

RTE NL provided the following email response to consultations:

> *"Do you know who will be considering the potential impact on TV reception in the area? If so could you forward me their contact details so I can consult with them.*
>
> *There should be no impact to any RTÉ NL links in the area."*

Note: RTE NL have been informed that Ai Bridges will be considering the potential impact on TV reception in the Upperchurch area.

3.1.6 Tetra Ireland Response to Consultations

Tetra Ireland provided the following email response to consultations:

"Based on the information provided this development does not cause us any network/coverage problems"

Upperchurch Windfarm, County Tipperary

Turbine ID	Easting	Northing
UCT1	194900	158957
UCT2	195136	159283
UCT3	195513	159435
UCT4	195885	159645
UCT5	196409	160330
UCT6	196015	160391
UCT7	196080	160032
UCT8	193386	160635
UCT9	193455	161035
UCT10	193558	162082
UCT11	195614	160417
UCT12	196559	161625
UCT13	196105	161649
UCT14	196409	161953
UCT15	196251	162315
UCT16	196692	162277
UCT17	197203	162448
UCT18	197224	162824
UCT19	196830	162616
UCT20	193023	160374
UCT21	193537	161812
UCT22	194615	160329
UCT23	193671	161365

3.1.7 Vodafone Response to Consultations

Vodafone provided the following email response to consultations:

> *"T9 and T23 pose a threat to services on the Vodafone Network and if possible should be considered for relocation to ensure an acceptable *perpendicular threshold distance of at least 75m."*

The graphic below was also provided by Vodafone Ireland and shows that they have one microwave radio link that traverses the wind farm. Vodafone refer to this link as link "TY013TY024".

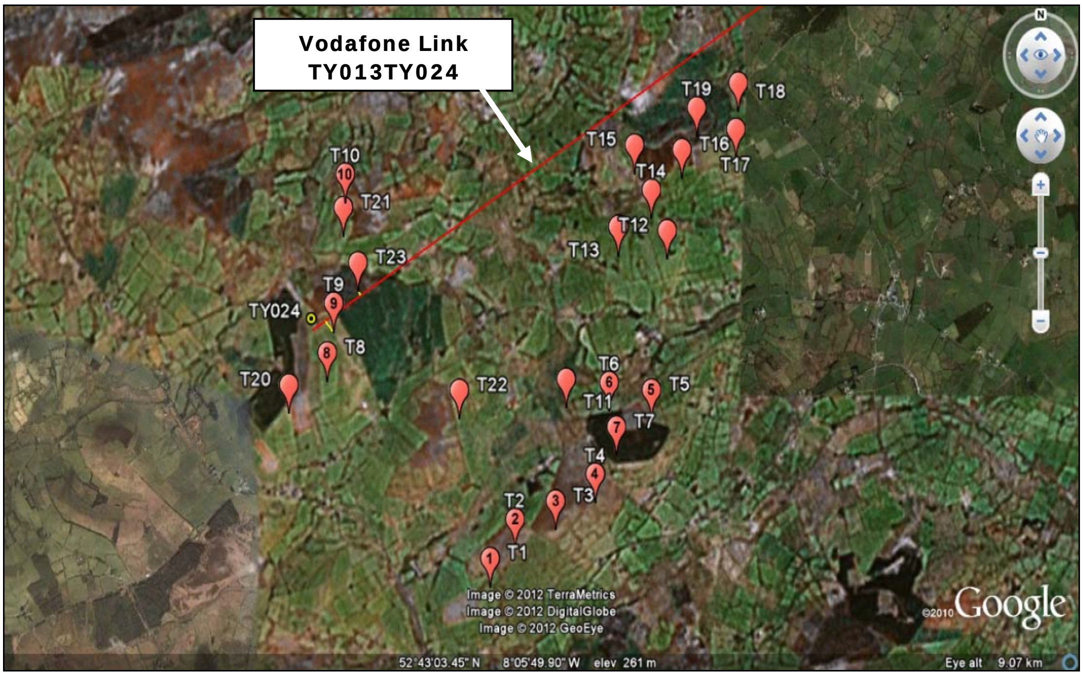


Figure 4. Vodafone Link TY013TY024 relative to the turbines at Upperchurch

**The "perpendicular threshold distance" referred to by Vodafone is the buffer or clearance distance between the turbine blade tip and the microwave radio link Fresnel Zone. See Figure 18 Section 6.1.1.1*

3.1.8 Munster Broadband Response to Consultations

To date, a final response from Munster Broadband regarding the Upperchurch wind farm development has not been received.

4. FIELD SURVEYS

Results from telecom operator consultations found that one communications site would be impacted by the proposed development. This communications site is located on Knockmaroe Hill and is shown below relative to the proposed turbines in Figure 5.

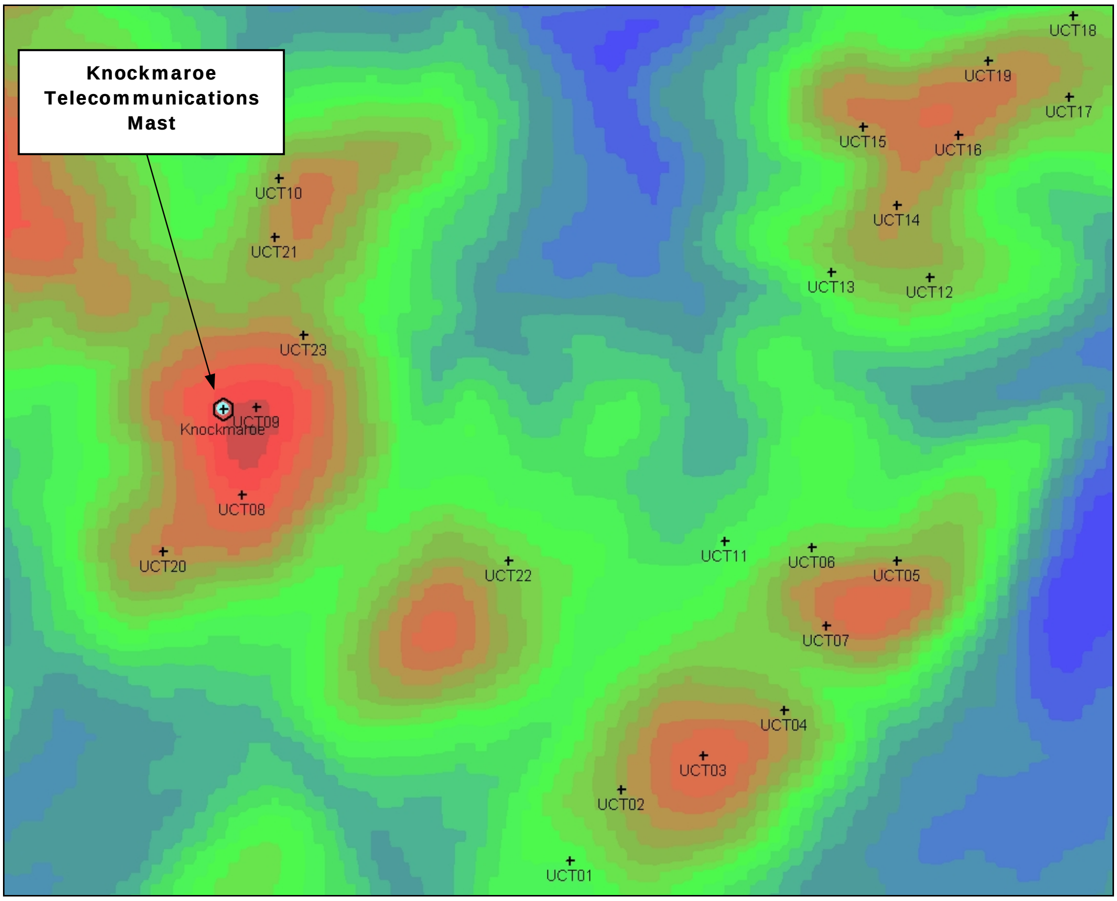


Figure 5. Knockmaroe Communications Mast near to the proposed Upperchurch wind farm development.

Field surveys of this site were carried out to identify the communications equipment that could be impacted by the proposed turbines. During the field survey, approximations of radio antenna size, bearing and height were made for the communications equipment installed on the mast. With this information, it was possible to assess if any of the turbines at Upperchurch would impact the communications infrastructure at Knockmaroe.

Section 4.1 that follows details the findings from the field surveys of the Knockmarore Telecoms Mast.

4.1 Telecommunications Mast at Knockmaroe

The field survey of the telecommunications mast at Knockmaroe found four types of communications equipment installed on the mast. A description of the equipment types are listed in Table 2 below.

Equipment Type	Description
Licensed Microwave Radios	This type of radio requires a frequency license (obtained from ComReg) to operate. Licensed Microwave Frequencies typically range from 7GHz to 38GHz.
Unlicensed Microwave Radios	This type of radio is permitted (by ComReg) to operate in the ISM 5.8 GHz radio band. Radio operators do not need a license from ComReg to used radio equipment in this frequency band.
GSM Panels	GSM panels are used to distribute GSM communications from the site to the mobile phone users.
3G Panels	3G panels are used to distribute 3G communications from the site to the mobile phone users.

Table 2. Equipment types installed at Knockmaroe mast

A large radio antenna is also installed at this communications site; however this radio is no longer in use and will not be impacted by the proposed turbines (Figure 6).

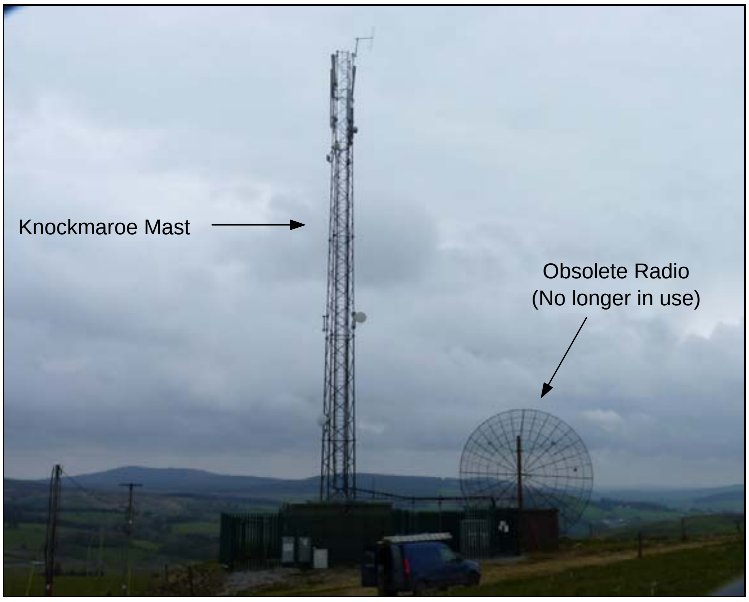


Figure 6. Telecommunications Mast at Knockmaroe

As the turbines at Upperchurch are positioned in a bearing range between 0° and 225° relative to the mast at Knockmaroe, the field survey focused on communications equipment which are aligned in this bearing range. Sections 4.1.1 and 4.1.2 that follow, present the communication equipment observed with alignments in this range.

4.1.1 Licensed & Unlicensed Microwave Radios at Knockmarore

Figure 7 below shows the Licensed & Unlicensed microwave radio equipment with bearing alignments that traverse the proposed wind farm (i.e. between 0° and 225°).

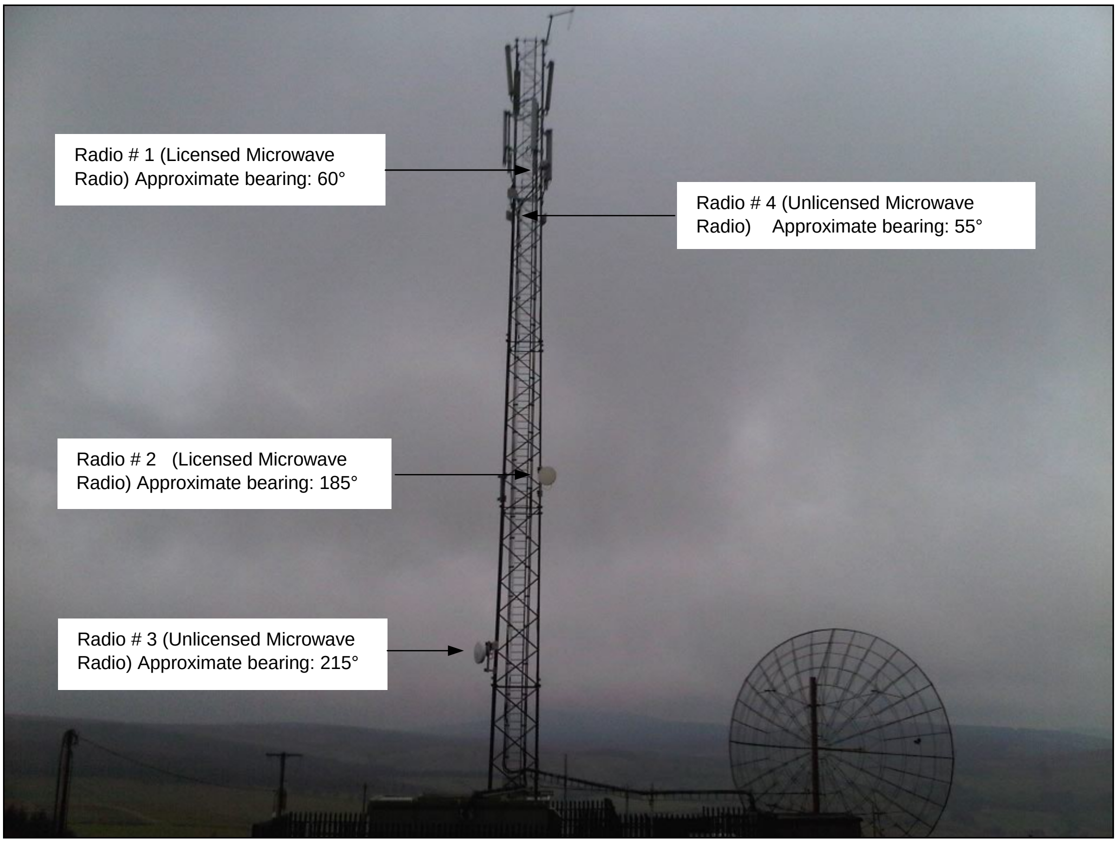


Figure 7. License & Unlicensed Microwave Radio Links at Knockmaroe mast.

Table 3 below, tabulates the microwave radio equipment at Knockmaroe and lists the bearing for each of the microwave radios. The telecom operators of each of these radios have been identified and are also shown in the table.

Microwave Radio ID	Licensed or Unlicensed	Telecoms Operator	Radio Bearing *
Radio # 1	Licensed	Vodafone	60°
Radio # 2	Licensed	Three Ireland	187°
Radio # 3	Unlicensed	Munster Broadband	215°
Radio # 4	Unlicensed	Munster Broadband	55°

Table 3. Licensed & Unlicensed radio equipment at Knockmaroe mast (0°- 225°).

** Approximate bearings recorded during field survey.*

4.1.2 GSM & 3G Panels at Knockmaroe Mast

During the field survey, two sets of radio panels (3 panels per set) were observed at Knockmaroe. The first set belongs to Vodafone and are GSM panels which are used to provide GSM network coverage for Vodafone's end customers. The second set belongs to Three Ireland and are 3G panels which are used to provide 3G network coverage for Three Ireland's end customers.

Figure 8. GSM & 3G Panels at Knockmaroe Mast

Wind turbines do not affect the operation of GSM technologies and the proposed wind farm development will have no impact on the operation of Vodafone's GSM panels. In some instances wind turbines can impact 3G network equipment operation; however Three Ireland's response to consultations stated that the proposed turbines are not detrimental to their network, thus no further analysis of GSM or 3G is carried out.

5. DESKTOP SURVEY AND ANALYSIS

To determine the microwave radios (licensed & unlicensed) that could be impacted by the Upperchurch development, each radio listed in Table 3 was plotted in radio planning software. From the results, it is possible to assess if the radios will or will not be impacted by the turbines. As the GSM and 3G services at Knockmaroe will not be impacted, a desktop analysis for these technologies is not required.

5.1 Licensed & Unlicensed Microwave Radios

Sections 5.1.1 to 5.1.4 below presents the finding of the desktop survey for each of radios listed in Table 3.

5.1.1 Radio # 1 Desktop Analysis

During the consultation process this radio was identified as one end of the Vodafone licensed microwave radio link between Knockmaroe and Knocknaharney, Borrisoleigh. The Vodafone reference ID for this link is "TY013TY024" (See section 3.1.7). This microwave radio link has been plotted in radio planning software and is shown below in Figure 9.

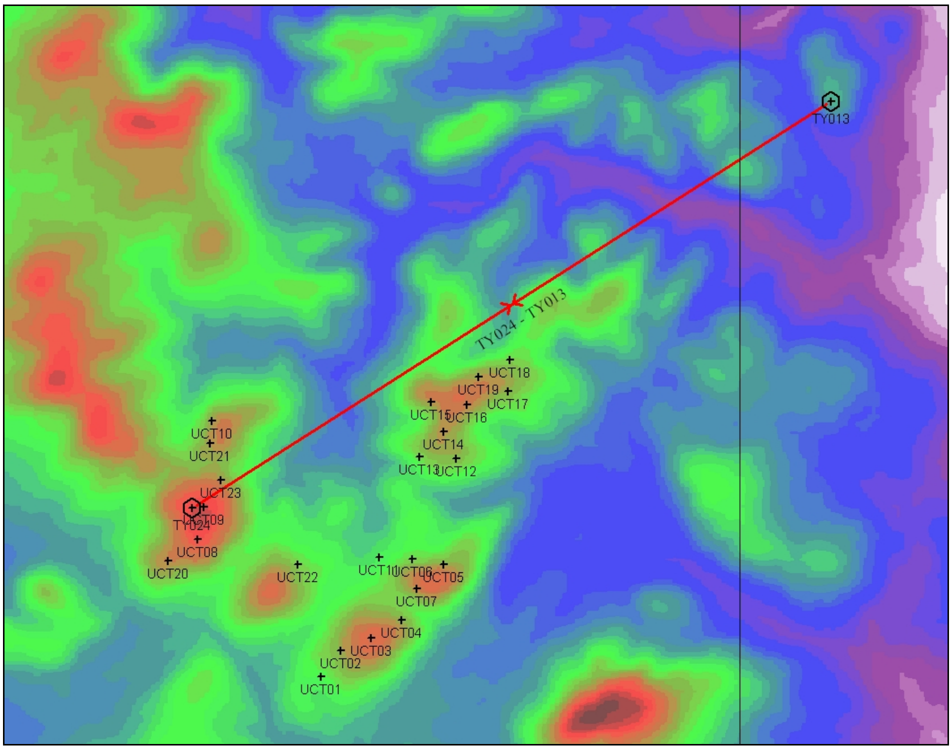


Figure 9. Vodafone's Licensed Microwave Radio Link "TY013TY024" – Radio # 1

Figure 10 below show turbines UCT09 and UCT23 relative to Vodafone's microwave link "TY013TY024". Around the centerline of the microwave radio link the *2nd Fresnel

Zone has also been plotted. The Fresnel Zone is an area which encapsulates the centerline of a microwave radio. Obstructions in this area can impact the operation of a microwave radio link. The Fresnel Zone of every microwave radio link is different and is dependent on the microwave radio link frequency and link distance.

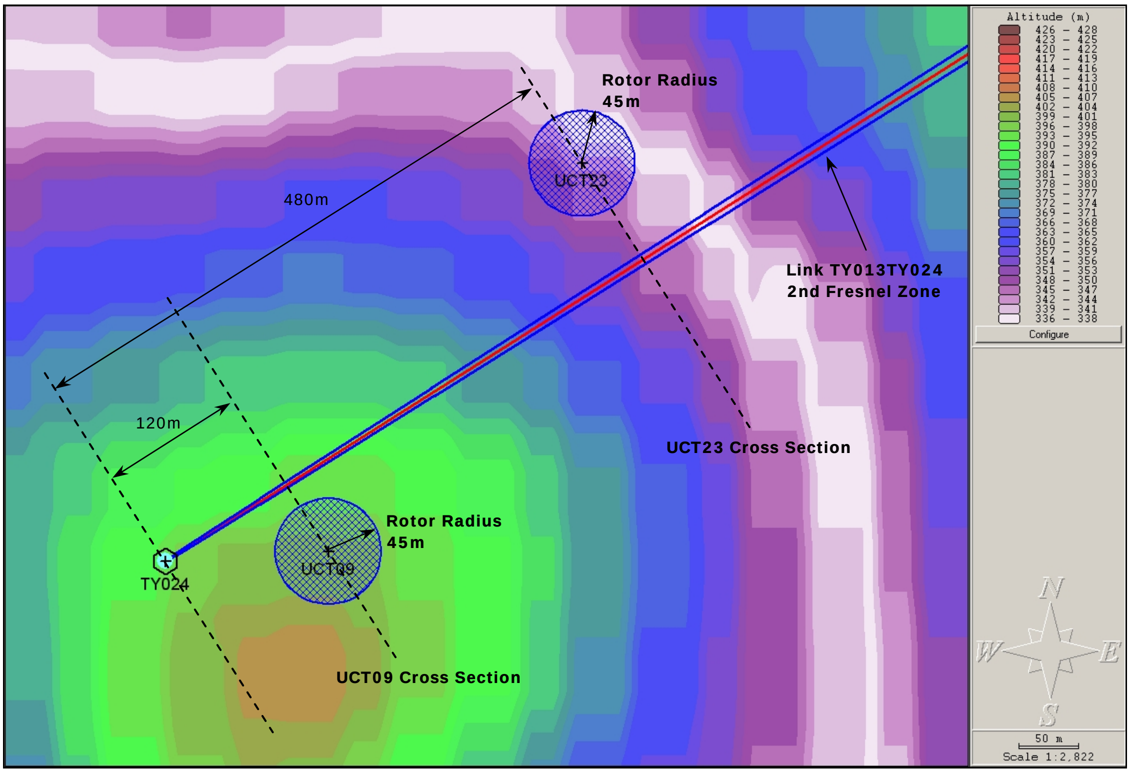


Figure 10. Turbines UCT09 & UCT23 Microwave Radio Link "TY013TY024" – Radio 1

In Sections 5.1.1.1 and 5.1.1.2 the clearance distances of turbines UCT09 and UCT23 to the microwave radio link "TY013TY024" are examined. To calculate the worse-case-scenario clearance distances, the 2nd Fresnel Zone of the microwave link has been used.

** Every microwave radio link has multiple Fresnel Zones (1st Fresnel Zone, 2nd Fresnel Zone, 3rd Fresnel Zone, etc). In radio frequency analysis, it is normal to use the 1st Fresnel Zone in radio interference calculations; however the 2nd Fresnel Zone is sometimes used to provide worse-case-scenario results as it encompasses a larger area around the centerline of the microwave link.*

5.1.1.1 Turbine UCT09

Figure 11 below shows a close-up view of Turbine UCT09 relative to the microwave radio link's 2nd Fresnel Zone.

To calculate the actual clearance distance between the turbine rotor tip and the 2nd Fresnel Zone, the vertical height of the turbine rotor and the microwave radio link centerline should be considered. It is also important that the heights used in the clearance calculations are obtained from the appropriate cross-section along the microwave radio link (Cross-section UCT09 in this case – See figure 12).

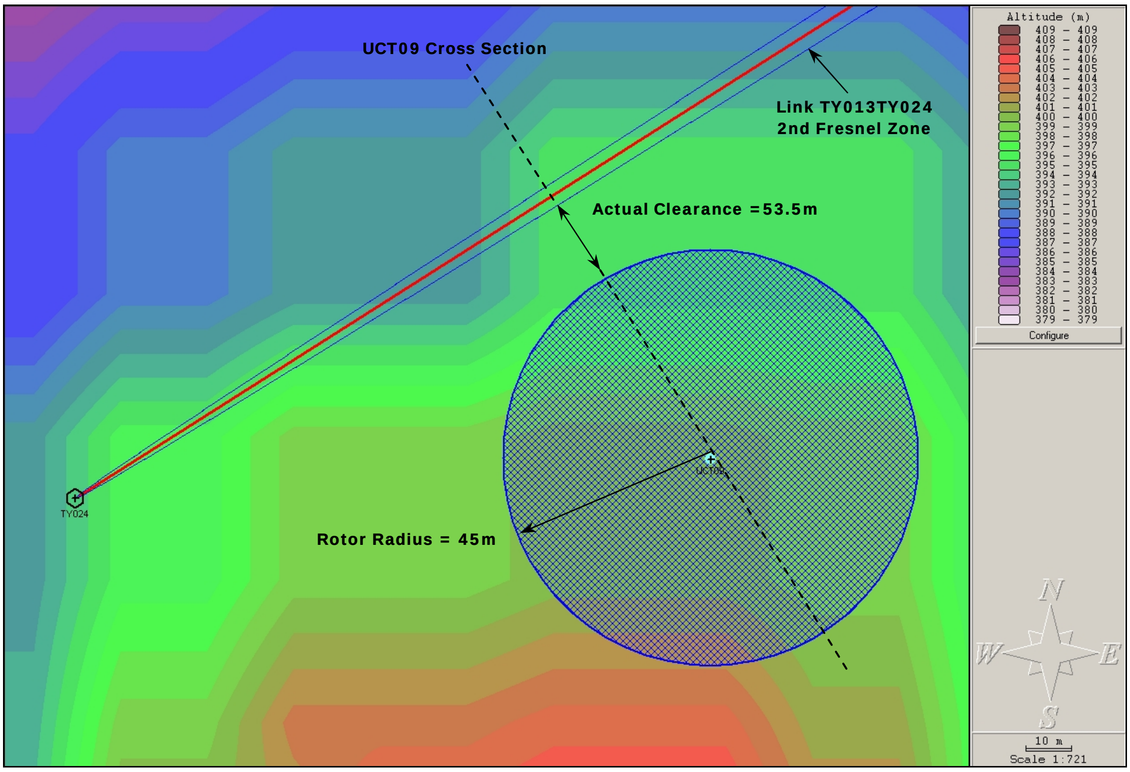


Figure 11. Close-up view of Turbine UCT09 relative to Microwave Radio Link "TY013TY024" – Radio 1

Figure 12 below shows the parameters that have been used to calculate the actual clearance between turbine UCT09 and the 2nd Fresnel Zone of the microwave radio link. The radio engineers who conducted these calculations (Ai Bridges Ltd.) consider that the **Actual Clearance** distance is **50m**. This distance is sufficiently far that the operation of this microwave radio link will not be impacted.

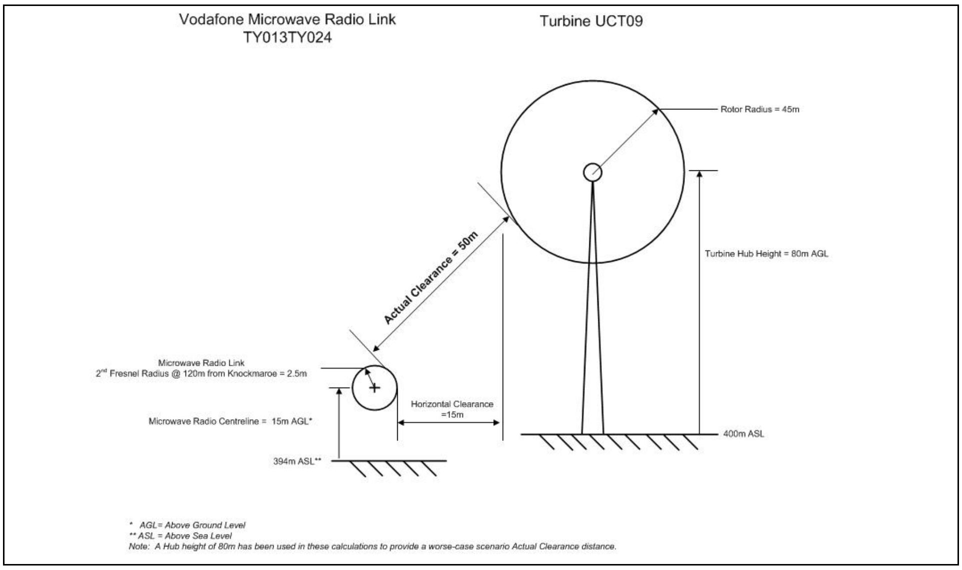


Figure 12. UCT09 Cross section view showing Actual Clearance distance.

5.1.1.2 Turbine UCT23

Figure 13 below shows a close-up view of Turbine UCT23 relative to the microwave radio link's 2nd Fresnel Zone.

To calculate the actual clearance distance between the turbine rotor tip and the 2nd Fresnel Zone, the vertical height of the turbine rotor and the microwave radio link centerline should be considered. It is also important that the heights used in the clearance calculations are obtained from the appropriate cross-section along the microwave radio link (Cross-section UCT23 in this case – See figure 14).

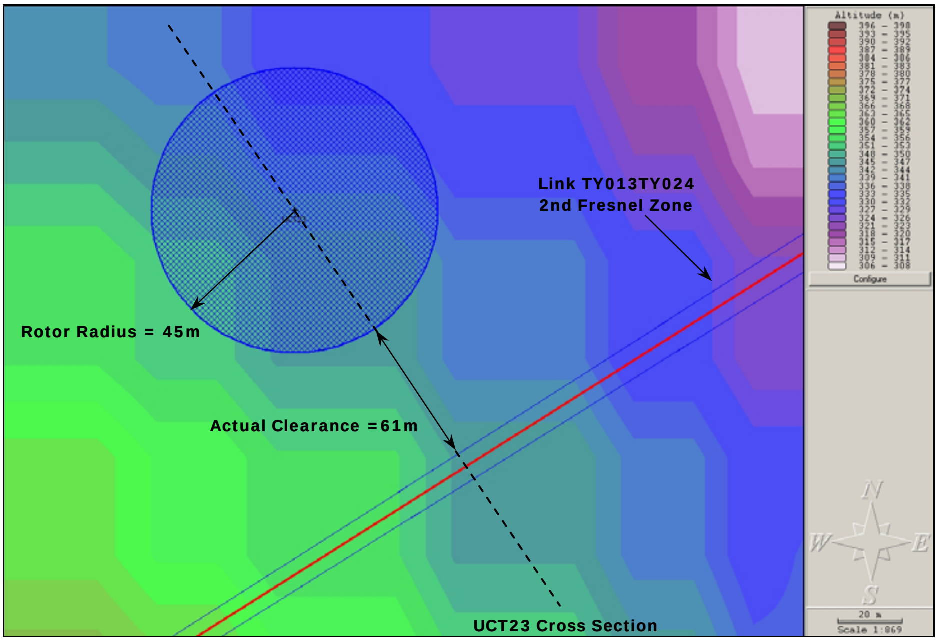


Figure 13. Close-up view of Turbine UCT23 relative to Microwave Radio Link "TY013TY024" – Radio 1

Figure 14 below shows the parameters that have been used to calculate the actual clearance between turbine UCT23 and the 2nd Fresnel Zone of the microwave radio link. The radio engineers who conducted these calculations (Ai Bridges Ltd.) consider that the **Actual Clearance** distance is **55m**. This distance is sufficiently far that the operation of this microwave radio link will not be impacted.

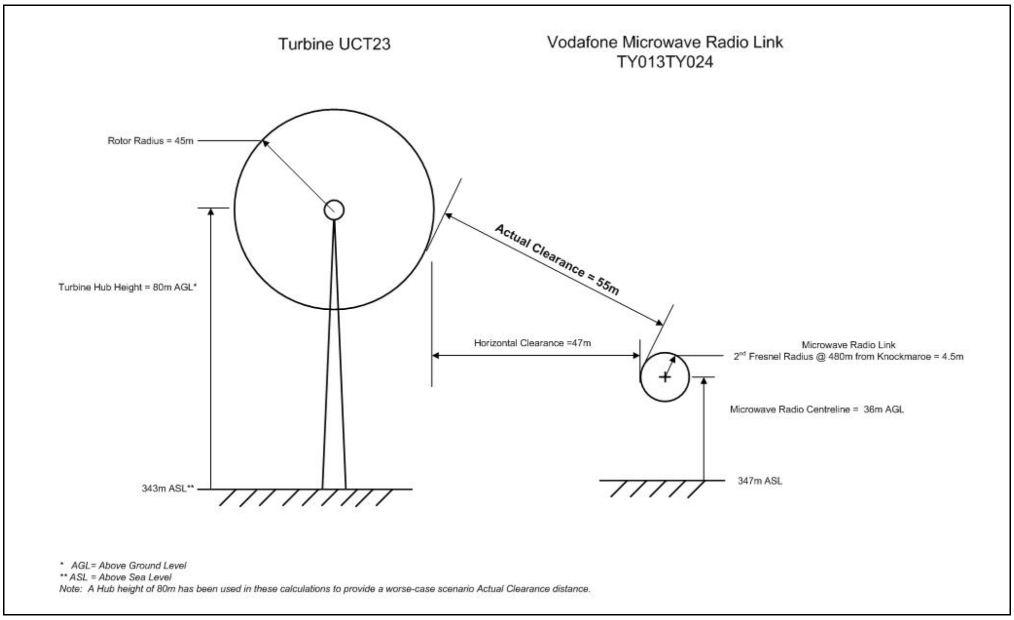


Figure 14. UCT23 Cross section view showing Actual Clearance distance.

5.1.2 Radio # 2 Desktop Analysis

During the consultation and field survey processes this radio was identified as one end of a licensed microwave radio link belonging to Three Ireland.

The nearest turbine to the centerline of this microwave radio link is turbine UCT08 and is a distance of more than 130m (This distance has been calculated using the same radio modeling software as described in Section 5.1.1). This distance is sufficiently far that that this licensed microwave radio link will not be impacted, thus further analysis of this link is not required.

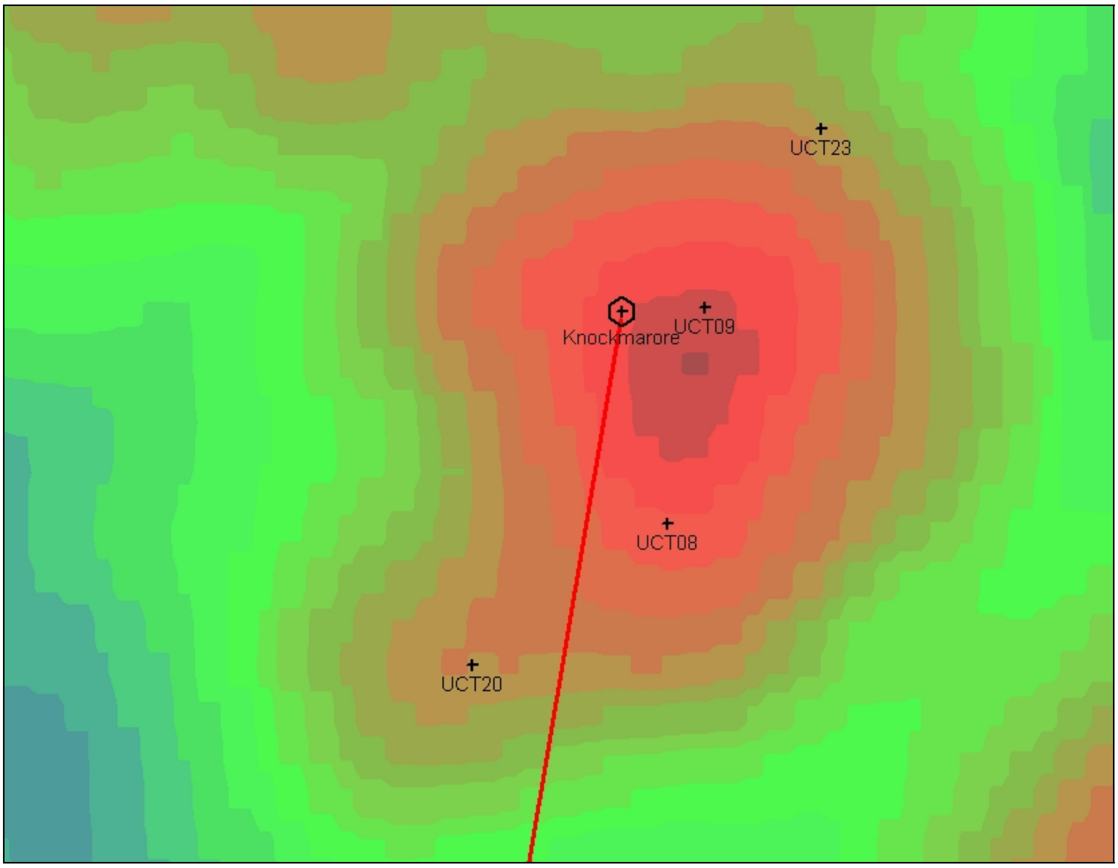


Figure 15. Three Ireland's Licensed Microwave Radio Link – Radio # 2

5.1.3 Radio # 3 Desktop Analysis

During the consultation process the owner of this unlicensed microwave radio was identified as Munster Broadband. This operator has not yet provided the details of the receiving end of this microwave radio link; however, the bearing of this radio was recorded as 215° during the field survey of Knockmaroe. For assessment purposes, a radio link on this bearing has been plotted in radio planning software and is shown below in Figure 16. Turbine UCT20 is more that 150m from the centerline of this microwave radio link (This distance has been calculated using the same radio modeling software as described in Section 5.1.1). This distance is sufficiently far that that this unlicensed microwave radio link will not be impacted, thus further analysis of this link is not required.

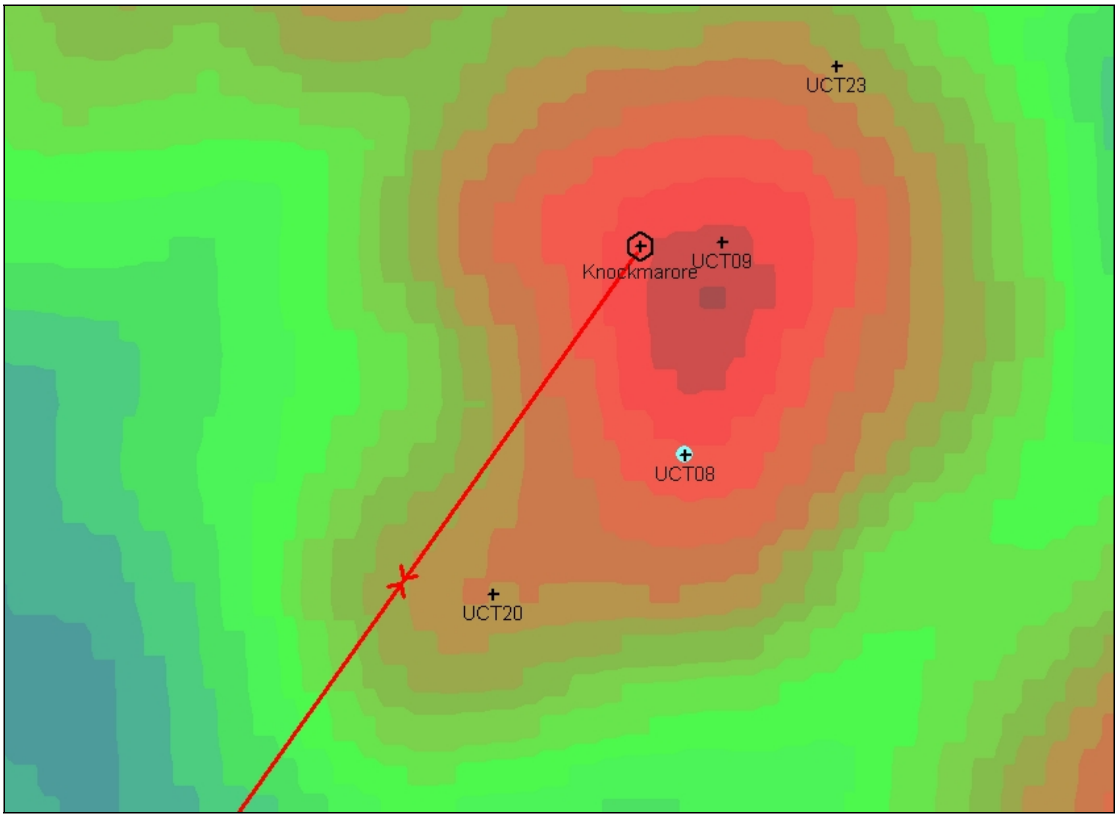


Figure 16. Munster Broadband's Unlicensed Microwave Radio # 3

5.1.4 Radio # 4 Desktop Analysis

During the consultation process the owner of this unlicensed microwave radio was identified as Munster Broadband. This operator has not yet provided the details of the remote end of this microwave radio link; however during the field survey the bearing of this radio was recorded as 55°. For assessment purposes, a radio link on this bearing has been plotted in radio planning software and is shown below in Figure 17. Turbine UCT23 is 74m from the centerline of this radio link (This distance has been calculated using the same radio modeling software as described in Section 5.1.1). From our analysis, this turbine is sufficiently far away that the operation of this unlicensed microwave radio link will not be impacted, thus further analysis of this link is not required.

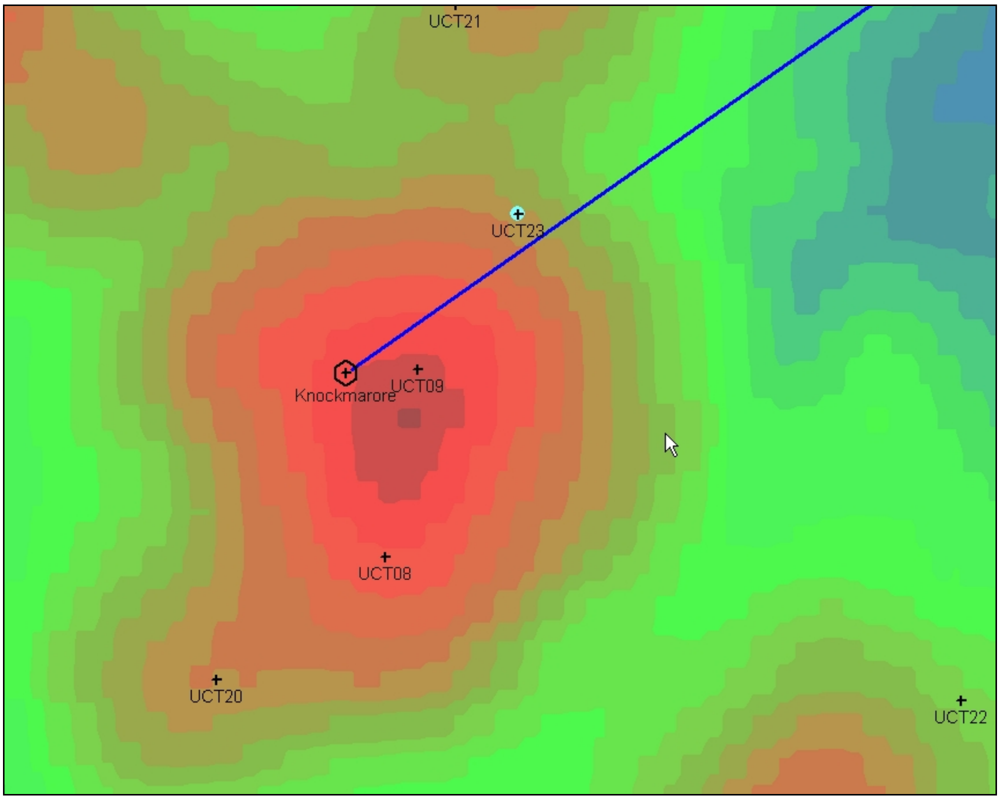


Figure 17. Munster Broadband's Unlicensed Microwave Radio # 4

6 TELECOMS MITIGATION MEASURES

As mentioned earlier in this report, the telecommunications site at Knockmaroe Hill is owned by one of the farmers involved in the Upperchurch wind farm development. The site owner informed the mast operator that they could put up a mast if it did not affect his involvement in the wind farm project. This information should be noted when considering if mitigation measures are necessary.

Section 6.1 below describes the mitigation measures available to the wind farm developer to offset the impact of the turbines on telecoms services in the Upperchurch area.

6.1 Telecoms Mitigation Measure Solutions

This report has found that no microwave radio links will be impacted by the proposed turbines at Upperchurch. Although Vodafone have raised concerns about the position of two turbines, desktop analysis shows that all turbines are sufficiently far away from Vodafone licensed microwave radio link. However for completeness, Section 6.1.1 below shows a mitigation solution which could be implemented in the event that the microwave radio link is impacted.

6.1.1 Provision of Relay Site

An option of offset the impact of turbines on any affected licensed microwave radio link would be to provision a relay site so that an alternative radio path could be used for communications to/from the Knockmaroe mast.

Turbines can be used as relay sites and Figure 20 below shows that turbine UCT21 would be an ideal site to relay the Vodafone microwave radio link to/from the Knockmaroe mast. Using turbine UCT21 as a relay site would eliminate any impact on Vodafone's link TY013TY024 due to turbines UCT09 or UCT23.

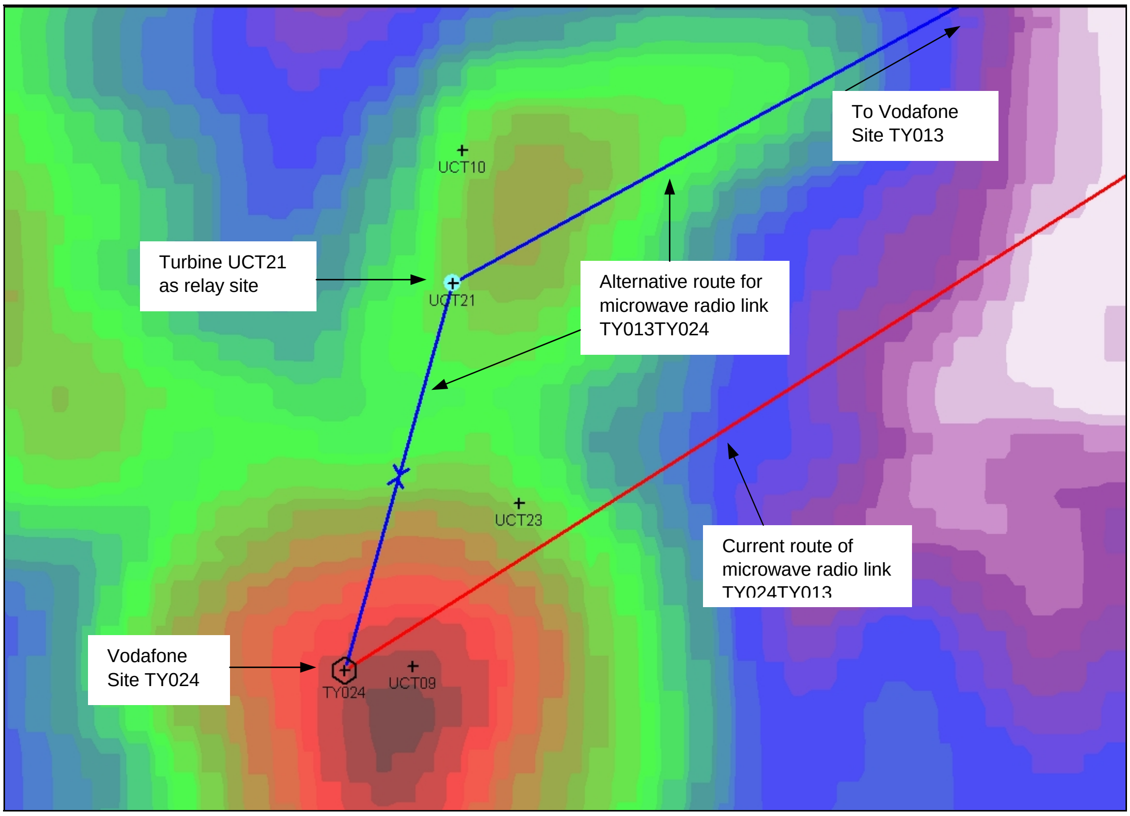


Figure 18. Turbine UCT21 as relay site for Vodafone link TY013TY024

7 CONCLUSIONS

Following the field / desktop surveys and the consultation responses from telecom operators the following conclusions have been made:

i) With the exception of Munster Broadband, consultation responses have been received from each of the telecom operators contacted. From the findings of this study the Munster Broadband communications equipment will not be impacted by the turbines and further consultations with this telecoms operator are not necessary.

ii) From the findings in this report no licensed or unlicensed microwave radio links will be impacted by the Upperchurch turbines. Although Vodafone have highlighted concerns about two turbines (UCT09 & UCT23) in relation to one of their licensed microwave radio links (TY013TY024), desktop analysis has shown that in the opinion of the Radio Engineers (Ai Bridges Ltd), the actual clearance distance between these turbines and the microwave radio link is sufficiently far that the operation of the link will not be impacted. Table 4 below shows the Actual Clearance distance between the two turbines and the 2nd Fresnel Zone of Vodafone's licensed microwave radio.

Turbine	Actual Clearance from Vodafone licensed microwave link TY013TY024
UCT09	50m
UCT23	55m

Table 4. Actual Clearance Distances

iii) Vodafone has a GSM service operating from Knockmaroe mast, however turbines do not impact GSM services and the development at Upperchurch should have no impact on the Vodafone GSM network. Three Ireland has a 3G service operating from the mast at Knockmaroe. In some instances wind turbines can impact 3G services; however Three Ireland's response to consultations stated that the proposed turbines are not detrimental to their network**.**

iv) Wind turbines can impact TV transmission networks and in their response to consultation RTE NL asked who will be considering the potential impact on TV reception in the area. RTE NL has been informed that Ai Bridges will be considering the potential impact on TV reception. RTE NL has also stated that the wind farm development will not impact any of their microwave radio links.

v) Tetra Ireland have confirmed that the there will be no impact to the Tetra network due to the turbines at Knockmaroe.

8 RECOMMENDATIONS

Following the results from, telecom operator consultations, field surveys and network analysis, the following recommendations have been made:

i) The findings in this report show that none of the Upperchurch turbines will impact Vodafone's licensed microwave radio link TY013TY024; however if there is an impact, the recommendation of the provision of a relay site on UCT21 will be implemented.

ii) Prior to the construction phase of the Upperchurch wind farm development it is recommended that a TV modeling report should be conducted. This TV modeling report should assess the potential interference that the development could cause to terrestrial TV services in the vicinity of the wind farm. It is also recommended that mitigation measures to offset any TV interference caused by the proposed wind turbines should also be provided in this report.

APPENDIX A - Turbine Co-ordinates

The turbine co-ordinates for the Upperchurch wind farm studied in this report are listed below in Figure A-1.

Turbine ID	Easting	Norhting
UCT1	194900	158957
UCT2	195136	159283
UCT3	195513	159435
UCT4	195885	159645
UCT5	196409	160330
UCT6	196015	160391
UCT7	196080	160032
UCT8	193386	160635
UCT9	193455	161035
UCT10	193558	162082
UCT11	195614	160417
UCT12	196559	161625
UCT13	196105	161649
UCT14	196409	161953
UCT15	196251	162315
UCT16	196692	162277
UCT17	197203	162448
UCT18	197224	162824
UCT19	196830	162616
UCT20	193023	160374
UCT21	193537	161812
UCT22	194615	160329
UCT23	193671	161365

Figure A-1 Upperchurch Turbine Co-ordinates

Report

APPENDIX 6-II TELECOMMUNICATIONS IMPACT STUDY

Appendix 6-1I B

Communications Impact Study with revised and final layout

Upperchurch Wind Farm Telecommunications Impact Study – December 2012 Turbine Layout

Ai Bridges - Telecommunication Consultants

Company:

Author: D. McGrath.

Approved for Release: Rev 1.1 David McGrath **Date:** 11/12/12

Document Filename: *Upperchurch Wind Farm Communications Impact Study - December 2012 Turbine Layout*

AiBridges Total Broadband Solutions	**Procedure: 001**	**Rev: 1.1**
Title: Upperchurch Wind Farm Communication Impact Study – Dec 2012 Turbine Layout	**Approved: DM**	**Date: 11/12/2012**

Communications Impact Study with revised and final layout

1. Introduction

This report was commissioned to review the impact to existing communication networks due to the revised changes to the Upperchurch turbine layout network. It should be read in conjunction with the previously submitted EMI report *"Upperchurch Wind Farm Communications Impact Study, 4th Sept 2012".*

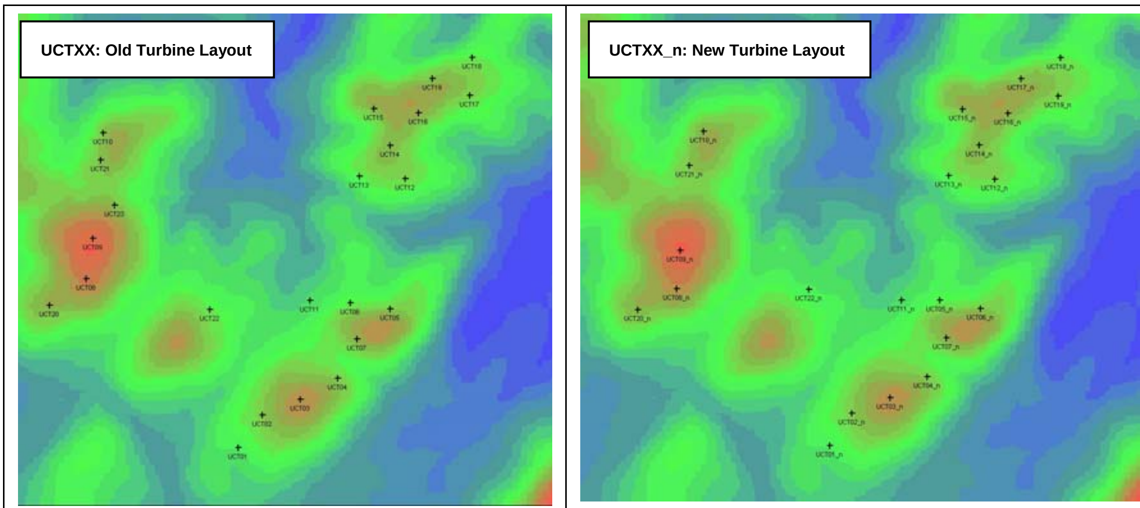
Figure 1 below shows the co-ordinates of the Original Turbine Layout along with the co-ordinates of the New Turbine Layout. In Section 2 of this report, we analyse the impact of the new turbine layout. Conclusions and Recommendations are provided in Sections 3 & 4 respectively.

Original Turbine Layout			New Turbine Layout		
Turbine ID	Easting	Northing	Turbine ID	Easting	Northing
UCT01	194900	158957	UCT01	194908	158961
UCT02	195136	159283	UCT02	195134	159279
UCT03	195513	159435	UCT03	195513	159435
UCT04	195885	159645	UCT04	195885	159645
UCT05	196409	160330	UCT05	196015	160411
UCT06	196015	160391	UCT06	196420	160324
UCT07	196080	160032	UCT07	196078	160033
UCT08	193386	160635	UCT08	193375	160528
UCT09	193455	161035	UCT09	193415	160903
UCT10	193558	162082	UCT10	193647	162090
UCT11	195614	160417	UCT11	195631	160413
UCT12	196559	161625	UCT12	196567	161609
UCT13	196105	161649	UCT13	196105	161649
UCT14	196409	161953	UCT14	196411	161955
UCT15	196251	162315	UCT15	196243	162310
UCT16	196692	162277	UCT16	196696	162271
UCT17	197203	162448	UCT17	196830	162616
UCT18	197224	162824	UCT18	197224	162824
UCT19	196830	162616	UCT19	197199	162441
UCT20	192992	160336	UCT20	192984	160316
UCT21	193537	161812	UCT21	193507	161751
UCT22	194615	160329	UCT22	194703	160517
UCT23	193671	161365	Removed	n/a	n/a

Figure 19. Old and New Turbine Layout Co-ordinates List

2. New Turbine Layout Analysis

The new turbine layout has been plotted relative to the original layout and is shown below in Figure 2.



Original Turbine Layout | **New Turbine Layout**

Figure 20. Original and New Turbine Layouts.

From the plot shown in Figure 2 we can see that there are only relatively small changes to the co-ordinates for most of the turbines in the new layout, with the exceptions listed in Table 1 below.

Turbine	Change in New Turbine Layout
UCT23	Turbine removed from the new layout.
UCT09	Turbine moved to a new location 137m to the southwest of its original position.
UCT20	Turbine moved to a new location 64m to the southwest of its original position.
UCT22	Turbine moved to a new location 208m to the northeast of its original position.
UCT21	Turbine moved to a new location 67m to the southwest of its original position.
UCT08	Turbine moved to a new location 109m to the south of its original position.
UCT10	Turbine moved to a new location 95m to the east of its original position.

Table 5. Notable changes in New Turbine Layout.

There are no significant impacts due to the changes to turbines UCT20, UCT22, UCT21, UCT08, UCT10 expected. However, as concerns were raised by two telecom operators: Vodafone and Three Ireland to the original locations of turbines UCT23, and UCT09 (See Section 3.1 Upperchurch Wind Farm Communications Impact Study, 4th Sept 2012*)* we examine the new layout in respect to both operators below.

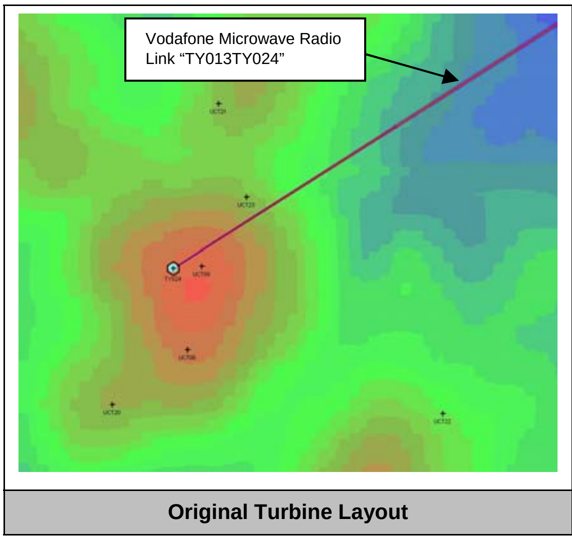
Vodafone Ireland

In the original EMI report "*Upperchurch Wind Farm Communications Impact Study, 4th Sept 2012 Section 3.1.7",* it had been noted that Vodafone Ireland had raised concerns about Turbine UCT23 and UCT09 in relation to one of their licensed microwave radio links (Link Reference ID: TY013TY024).

> **3.1.7 Vodafone Response to Consultations**
> *Vodafone provided the following email response to consultations:*
> *"T9 and T23 pose a threat to services on the Vodafone Network and if possible should be considered for relocation to ensure an acceptable *perpendicular threshold distance of at least 75m."*

From our analysis, none of the turbines in the new turbine layout will impact this Vodafone link, as UCT23 has been removed from the development plans and UCT09 has been moved further away from the radio link. The new location of turbine UCT09 is 137m to the southwest from its original position. In its new location it is 157m from the Vodafone Licensed Radio Link "TY013TY024" and poses no threat to the operation of this radio link.

Figure 3 below shows a close-up view showing the Old and New Turbine Layouts relative to Vodafone's microwave radio link "TY013TY024".



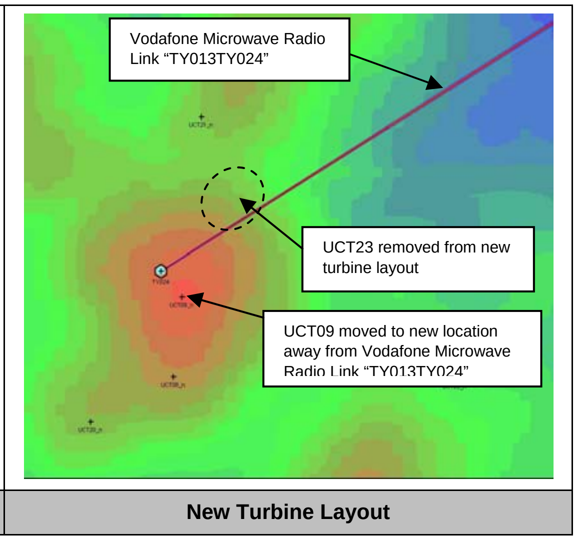


Figure 21. Close-up view of Original and New Turbine Layouts relative to Vodafone Microwave Radio Link "TY013TY024"

Three Ireland

In the original EMI report Three Ireland requested that they be notified of any changes to the position of Turbine UCT09. (See below for relevant excerpt from *Upperchurch Wind Farm Communications Impact Study, 4th Sept 2012 Section 3.1.1",*

> ***3.1.1 Three Ireland Response to Consultations***
>
> *Three Ireland provided the following email response to consultations:*
> *"The turbine that is causing concern for 3 Ireland is UCT9. This is approximately 150m away from the site *TP Foilnaman Tower . Whilst the impact of the proposed location of UCT9 is not ideal, it is not detrimental to the 3 Ireland **RF network.*
> *However if the location of UCT9 changes in any way we would like to be consulted on this."*

Note: As per Three Ireland's request, they have been notified of the change in position of this turbine. To date, no response has been received from Three Ireland regarding the new position of Turbine UCT09.

> **From:** David McGrath
> **Sent:** 06 December 2012 10:27
> **Cc:** Kevin Hayes; logistics; Support
> **Subject:** RE: Request for Information - Upperchurch Wind Farm
>
> Hello Malachy,
>
> Further to you request below regarding the location of turbine UCT09
> We wish to inform you that the proposed location of this turbine has been modified.
> The old and new turbine co-ordinates are shown below.
>
> **OLD co-ordinate for turbine UCT09**
> 193455 E
> 161035 N
>
> **NEW co-ordinate for turbine UCT09**
> 193415 E
> 160903 N
>
> Please let us know if you have any issues with the new proposed position of turbine UCT09.
>
> Best Regards,
> David McGrath.

3. Conclusions

Following the findings in this report the following conclusions have been made:

i) Turbine UCT23 has been removed from the original turbine layout and no longer poses a threat to Vodafone's licensed microwave radio link "TY013TY024"

ii) Turbine UCT09 has been moved 137m from its original location to a position which is 157m from Vodafone's licensed microwave radio link "TY013TY024". In its new location, this turbine should have no impact on the operation Vodafone's radio link.

iii) In previous consultations with Three Ireland they requested to be notified of any changes to the position of Turbine UCT09. The new position of this turbine is 137m from its original proposed location and Three Ireland have been notified of this change. To date no response has been received from Three Ireland regarding the new position of this turbine.

APPENDIX 6-III: EMAIL RESPONSE FROM IRISH AVIATION AUTHORITY (IAA)

EMAIL FROM JACK BRETT (ECOPOWER DEVELOPMENTS) TO DEIRDRE FORREST (IAA)

From: Jack Brett [mailto:jackb@ecopower.ie]
Sent: 08 October 2012 18:31
To: FORREST Deirdre
Subject: Re: Upperchurch Windfarm Location

Hi Deirdre,

The Wind Turbine hub height is up to 80m and the overall blade tip height is up to 126.6m

As request, please find attached map showing the location of the proposed Upperchurch Windfarm.

Regards
Jack Brett

Ecopower Developments Ltd
Sion Road
Kilkenny

Office: 0567750140
Mobile: 0863575310

REPLY EMAIL FROM DEIRDRE FORREST (IAA) TO JACK BRETT (ECOPOWER DEVELOPMENTS)

From: FORREST Deirdre [mailto:Deirdre.FORREST@IAA.ie]
Sent: 10 October 2012 14:45
To: Jack Brett
Subject: RE: Upperchurch Windfarm Location

Hi Jack

After looking at the proposal the IAA will require an agreed lighting scheme, notification 30 days prior to construction and as built coordinates of the completed development for charting purposes.

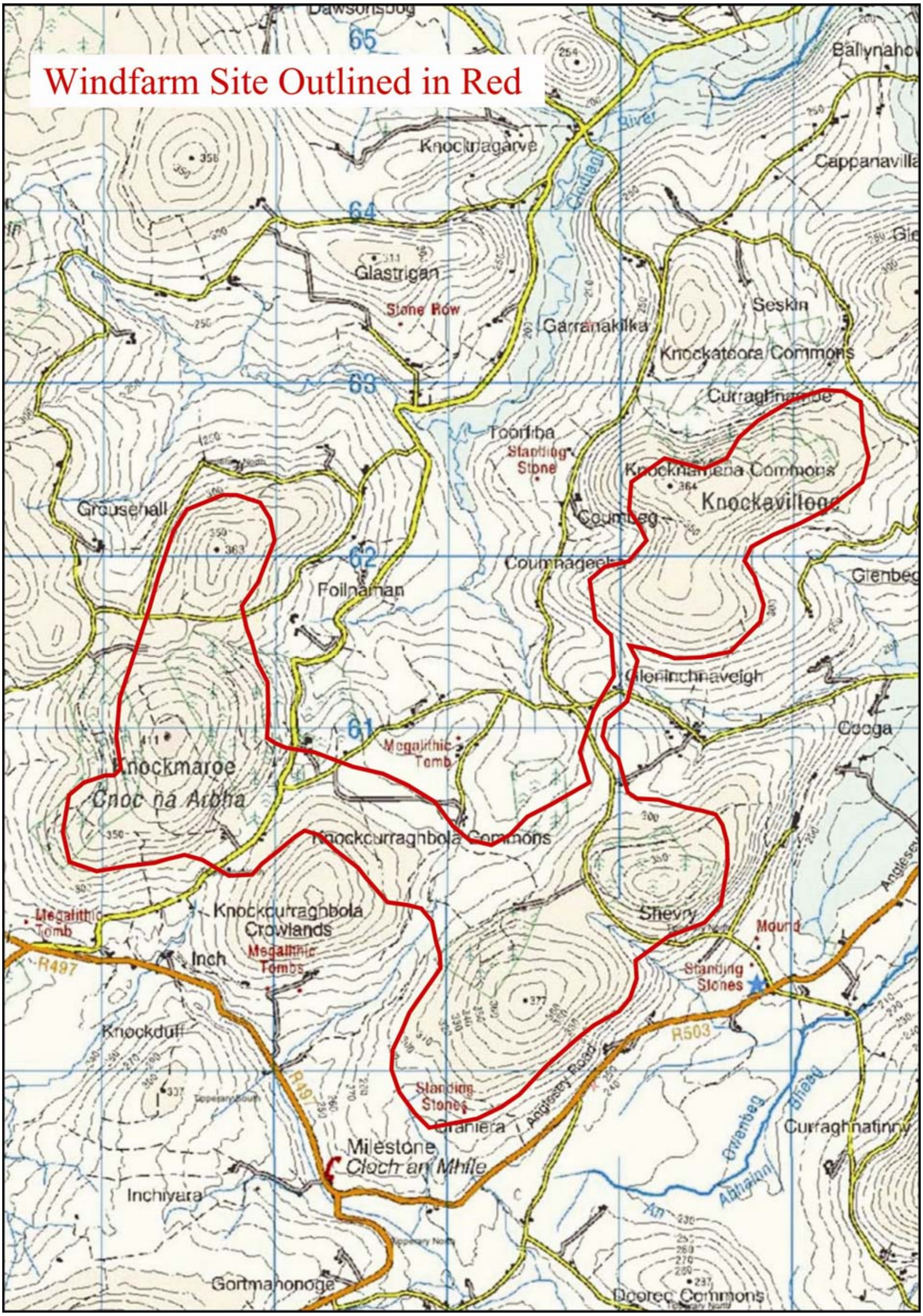
Many thanks
Deirdre Forrest

The Irish Aviation Authority (IAA)
The Times Building,

11-12 D'Olier Street,

Dublin 2

EMAIL ATTACHMENT SENT TO IAA 8TH OCTOBER 2012



7. Construction Impacts and Employment

7.1 INTRODUCTION

This section addresses the impacts on the road network and traffic resulting from the construction and operation of the proposed Upperchurch turbines. Effects on employment in the region are also discussed.

7.1.1 Access routes during the Construction Phase

7.1.1.1 Access Road from Port

The turbine components will be delivered either from Dublin port or Foynes port. If the components are delivered from Dublin Port they will be transported west along the M7 to the Nenagh by-pass and turn onto the R498 at Knockalton Upper. If the turbine components are delivered from Foynes Port they will be transported east on the M7 to the Nenagh by-pass and turn right on the R498 at Knockalton Upper. The traffic will then travel the R498 into Thurles and turnaround at the Tipperary Institute roundabout and travel back up the R498 for 2.5km in order to effect the turn left onto the R503 after the Racecourse at Killianan Junction.

The vehicles will travel west along the R503 for 16km as far as Graniera, 1km before Milestone, turning right into Site Entrance No. 1. From this point the construction vehicles will access the full site using newly built windfarm roadways, upgraded farm and forestry tracks and site entrances from the Third Class Road network within the site area. See **Figure 7-1: Turbine Components Haul Route** and **Figure 7-2: Site Entrance Locations** at the end of this chapter.

The haul route as far as Graniera has already been used for large turbine component deliveries to Glenough Windfarm and Garracummer Windfarm, which are both in South Tipperary just south of the Upperchurch windfarm site. The haul route from M7 comprises 54.4km of Regional Road; the R503 and the R498, both of which have been used previously to delivery turbine components.

A review of the approach roads will be carried out with the County Roads Engineer prior to commencing construction.

7.1.1.2 Traffic Management

During construction, access for heavy plant such as cranes and excavators would be required. Turbine components will be transported to site on articulated trucks. In general traffic would heaviest during the construction of roadways and foundations. The construction entrance at Graniera is an existing field gate on Regional Road the R503. It is proposed that this entrance will only be used for construction traffic and after the construction phase this entrance will be closed. During the operational phase the turbines at will be accessed from the local road construction entrances in Knockmaroe, Knockcurraghbola Commons, Shevry, Grousehall and Knocknamena Commons.

All construction entrances have been designed having regard to the North Tipperary County Development Plan and the National Roads Authority Geometric Design of Major/Minor Priority Junctions and Vehicular Access to National Roads.

In order to mitigate for this increased road use, principles of good traffic management will be applied. Deliveries of heavy equipment can be scheduled to cause minimal disturbance to the local residents.

7.2 ACCESS REQUIREMENTS

The access requirements can be divided into five phases

- Civil engineering works
- Electrical works
- Wind turbine delivery and erection
- Routine inspection and maintenance
- Major maintenance and final decommissioning

7.2.1 Civil Engineering Works

7.2.1.1 On site roads and hardstands

The Upperchurch on-site roads (8km) and hardstands will be laid to a depth of 400mm with crushed stone. The roadway including both new and upgraded existing forestry and farm roads along with hardstanding areas will require approximately 4,010 loads of crushed stone. The developer will endeavour to win as much of this stone as possible from borrow pits onsite to reduce the volume of construction traffic.

7.2.1.2 Turbine Foundations

Foundations for the 22 turbines will require approximately 345m³ per base. This amounts to approximately 950 truckloads of readymix concrete required for the 22 bases.

Other building materials, including pre-cast concrete pipes for drainage will be procured locally. Crushed stone not won on site, sand and concrete products will be sourced from local suppliers.

7.2.1.3 Steel Reinforcing

14 tonnes per turbine will be needed. This amounts to approximately 15 deliveries by flatbed articulated lorry in total.

7.2.1.4 Haul Route Surveys

Prior to construction, Pavement Condition Surveys to include FWD analysis, width and forward stopping sight distance analysis and culvert/bridge strength analysis, will be carried out on the local roads that transverse the Upperchurch windfarm site to determine suitability for use and whether they will require to be strengthened and/or restored after the construction phase. Any strengthening or reinstatement required will be carried out by the developer in agreement with the Roads Department. The haul route proposed as far as the site entrance at Graniera has just been used for the construction traffic for Garracummer windfarm and previously for Glenough Windfarm.

7.2.2 Traffic for Electrical Works

The following deliveries will be required

- articulated lorries carrying cable rolls – 1 load
- delivery lorries carrying equipment for the turbines - 1 load

7.2.3 Wind Turbine Delivery and Erection

The components will be delivered to the site by articulated trucks. The maximum load per axle, for delivery of the turbine components and construction materials will be confined to within legal limits.

A proposed route for carriage of turbine components from the M7 was discussed with the North Tipperary Area Roads Engineers. The entire haul route is within the Newport Area and Thurles Area. Any strengthening or reinstatement required will be carried out by the developer in agreement with the roads engineers. **Figure 7-1: Turbine Components Haul Route** at the back of this chapter.

The erection of wind turbines involves the assembly and lifting into position of the main components of the turbine (the tower, nacelle and rotor assembly).

The following loads are required per turbine:-

Table 1: **Turbine Delivery Details**

Component	**Transportation Requirement**
Nacelle (2 loads)	2 truck load-carried on a 8 axle rear- steering trailer and 3 axle tractor unit
Tower section (top)	1 truck load (carried on 5 axle rear steering trailer and 3 axle tractor unit)
Tower section (middle)	1 truck load (carried on 5 axle rear steering trailer and 3 axle tractor unit)
Tower section (bottom)	1 truck load (carried on 5 axle rear steering trailer and 3 axle tractor unit)
3 Blades	1 truck load per blade (carried on 2 axle rear steering trailer and 2 axle tractor unit)

This amounts to approximately 8 truckloads per turbine with a total number of 176 deliveries over the delivery period for all 22 turbines. Axle weights per axle will not exceed legal limits.

7.2.3.1 Craning Requirements

A crane, with a lifting capacity of circa.500 tonnes, will be used to remove the heavier components from the lorries and for the erection of the turbines. This crane will likely be an 8 axle, crane weighing approx. 97 tons. It will be equipped with large low ground pressure tyres carrying approx. 12 tons per axle. A smaller crane will be used to remove the blades from the trailer and for assisting assembly (tailing of the turbines).

7.2.4 Routine Inspection and Maintenance

The operational phase will involve daily remote monitoring by the owner's operator and visits by maintenance crews to carry out scheduled and un-scheduled maintenance and repairs. A light four-wheel drive vehicle will be required for access for maintenance personnel. On the few occasions of major component failure a crane would be needed to be brought on site.

7.2.5 Mitigation Measures

A detailed condition survey of the public roads throughout the site would be necessary in liaison with the County Council Roads Engineer, prior to commencement of construction works. The objective being to identify those sections of road which may require strengthening or re-alignment and as a basis for agreeing remedial works to be carried out by the developer on completion of the project.

The haul route on Regional Roads as far as site entrance No. 1 at Graniera has been used before for the delivery of similar size turbines to Glenough Windfarm and Garracummer Windfarm, both in South Tipperary. Site Entrance No. 1 will be designed so that the component delivery trucks will be able to completely clear the R503 before they reach the gates of the construction site (**Figure 7.3** at the end of this Chapter). It is proposed that this entrance will be closed on completion of the construction phase and will only be used during the operational phase in the case of a necessary replacement of a major component or for decommissioning the windfarm. The other entrances from the Third Class roads throughout the site will be used for operation and maintenance traffic, which will mainly be four wheel drive vehicles and vans.

Traffic control will be provided for, while transporting oversized loads to the site. Movement of oversized loads will be co-ordinated with the local authorities and Gardai.

Temporary facilities will be provided on the proposed site for construction traffic parking, temporary site offices and storage areas.

The promoter will at all times ensure that inconvenience to local people is minimised and would schedule traffic flow to achieve this.

7.3 CONSTRUCTION METHODS FOR ROADS AND FOUNDATIONS

7.3.1 Road Construction

Prior to the designing of the roadways the geotechnical and hydrological conditions that exists on site were assessed and trial pits were excavated at 20 of the proposed turbine sites and peat depth and classification was measured at the remaining two sites (T05 & T14) which are in forested areas. Ground surface slope was measured at all turbine sites. These investigations were carried out in order to classify the depths and nature of the soil and underlying sub-soil.

The locations of these trial pits and descriptions of conditions found are in Chapter 14 **Appendix 14-I**.

In 18 out of the 20 trial pits that were excavated, bedrock was encountered at an average depth of 1.90m below the surface, the minimum and maximum depths being 1.20m and 2.90m respectively. Bedrock consisted of siltstone or hard shale. The two remaining trial pits were excavated in stiff clay to depths of 1.50m and 2.70m. Some bedrock will be excavated for the turbine bases where it is shallow although the volumes will be minimal.

A number of suitable locations have been identified for borrow pits for the extraction of material for road construction within the site. The position of the borrow pits are shown in Chapter 14 Table 14.3

Peat was found at 3 of the 22 turbine base locations but because of the shallow depths of the peat which was encountered there and the inherent stability of the sub-soils on site there is no particular risk to ground stability on any part of the wind farm site.

A full report on the geotechnical assessment carried out on the proposed site is contained in Chapter 14 Geotechnical impact Assessment.

The final layout of the roads and turbines was planned following a thorough walkover of the site and trial pit investigations and also considering the contours of the land and the gradients of the slopes on site.

7.3.2 Mitigation measures

The first priority of the construction phase will be to construct the on-site road network and upgrade the existing on-site roads, so that they are capped with limestone or similar quality stone to reduce wear and tear during the construction phase. Vehicular movements will be restricted to the footprint of the proposed development. This implies that machinery will be kept on the site roads and hardstanding areas and aside, from advancing excavations, avoid moving onto areas not delineated on the site drawings.

The geotechnical investigations at the proposed Upperchurch windfarm site indicate that the site has a very low risk of slope failures or landslides due to the virtual absence of peat there. Slopes are moderate over most of the development footprint. It is noted that geotechnical investigations indicate stable conditions throughout the extent of the areas investigated and therefore constraint mapping was not required for this site. As a pre-cautionary principle, however, the following procedures are recommended as best-practise mitigation measures to avoid slope instability, even of a very local nature, at wind farm sites. These are:

- Drains will be established to effectively drain grounds prior to excavation or earthworks of each section of road. Such drains will be positioned at an oblique angle to slope contours to ensure ground stability;
- All site excavations and construction will be supervised by a suitably qualified engineer. The contractor's method statement will be reviewed and approved by a suitably qualified geotechnical engineer prior to site operations.

All excavated earth materials must be either re-used in an environmentally appropriate and safe manner, e.g. used for landscaping, or removed from the development site at the end of the construction phase.

A construction phase Environmental Management Plan will be incorporated to include regular checking of equipment, materials storage and transfer areas, drainage structures and their attenuation ability during the construction phase of the project. The purpose of this management control is to ensure that the measures that are put in place continue to operate effectively, to prevent accidental leakages, and to identify potential breaches in the protective retention and attenuation network during earthworks operations.

Also a fuel management plan will be implemented. This plan will incorporate the following elements:

- Mobile bowsers, tanks and drums will be stored in secure, impermeable storage areas away from drains and open water;
- Fuel containers will be stored within a secondary containment system, e.g. bunds for static tanks or a drip tray for mobile stores;
- Ancillary equipment such as hoses and pipes will be contained within the bund;
- Taps, nozzles or valves will be fitted with a lock system;
- Fuel and oil stores including tanks and drums will be regularly inspected for leaks and signs of damage;
- Only designated trained operators will be authorised to refuel plant on site;
- Procedures and contingency plans will be set up to deal with emergency accidents or spills; and
- An emergency spill kit with oil boom, absorbers etc. is to be kept on site for use in the event of an accidental spill.

7.4 WATER RUN-OFF

The upgrading of 3.6km of existing farm tracks, the excavation of 8km of new roadways, along with additional drainage for the construction of the turbines and control building will result in the disturbance of localised areas of soil and subsoil.

The proposed site drains into streams that form the upper reaches of the Turraheen, Owenbeg, Clodiagh and Aughvana Rivers. The first three of these rivers form part of the South Eastern River Basin District and ultimately join the River Suir to the southeast. The Aughvana River, which forms part of the Shannon River Basin District, joins the Mulkear River and ultimately flows into the River Shannon to the east of Limerick City.

Erosion control where runoff is prevented from flowing across exposed ground and sediment control where runoff is slowed to allow suspended sediment to settle are important elements in runoff and sediment control. A Sediment and Erosion Control Plan has been prepared (See Chapter 15 **Appendix15-I**) and will be implemented to prevent sediment and pollutant runoff into the local watercourses during the construction phase. The plan includes the following elements:

- The plan effectively consist of restoring and maintaining the existing drainage network along the existing access track and roads where it exists and integrating it with newly constructed drainage required for upgraded and new roads.
- No work will take place within 50m buffer zones of watercourses, except at crossings.
- All construction method statements will be prepared in consultation with Inland Fisheries Ireland – South Eastern River Basin District and Shannon River Basin District.
- The area of exposed ground will be kept to a minimum by maintaining, where possible, existing vegetation.
- Temporary deposition areas will be designated and designed to hold temporary stockpiles and will be located away from drains and watercourses.
- Stockpiles that are at risk of erosion will be protected by silt trapping apparatus such as a geo-textile silt fence to prevent contaminated runoff.
- Silt fences or other appropriate silt retention measures will be installed where there is a risk of erosion runoff to watercourses from construction related activity, particularly during prolonged wet weather periods or following an intense rainfall event.
- The silt retention measures where they are installed will be inspected and maintained on a regular basis throughout the construction and operation phases of the wind farm.
- All associated tree felling will be undertaken using good working practices as outlined by the Forest Service in their ‘Forestry Harvesting and Environment Guidelines’ (Forest Service, 2000a) and the ‘Forestry and Water Quality Guidelines ‘(Forest Service, 2000b). The latter guidelines deal with sensitive areas, erosion, buffer zone guidelines for aquatic zones, ground preparation and drainage, chemicals, fuel and machine oils.
- Drainage ditches or other suitable measures will be adopted alongside access roads, turbines and other disturbed areas to prevent silt or contamination from construction water runoff entering watercourses.
- Check dams will be placed at regular intervals based on slope gradient along all drains to slow down runoff so as to encourage settlement and to reduce scour and ditch erosion.
- Drains carrying construction site runoff will be diverted into silt traps.
- Wheel washes will be provided for exiting heavy vehicles to ensure roads outside of the site boundary are clean.

- Pumped or tremmied concrete will be monitored carefully to ensure no accidental discharge into local watercourses.
- A programme of inspection and maintenance of drainage and sediment control measures during construction will be designed and dedicated construction personnel assigned to manage this programme.
- Water quality monitoring will be carried out in years 1 and 2 of operation to determine whether water quality has been impacted. Monitoring of water quality parameters will be conducted monthly in Year 1. If thresholds are not exceeded in Year 1, then the effort may be reduced in Year 2.

7.4.1 Turbine Foundations and crane pad areas

It is proposed that the turbine foundations will extend to a depth 2.0m. At locations where competent bedrock is encountered the foundations for the turbines will be keyed into the bedrock. In locations where the subsoil (or subsoil and broken rock) thickness is greater than 2.0m the foundations may need to be deeper or some pile foundations may need to be installed.

There will be 22 turbine foundation bases and crane pads. The bases will be approximately 17m in diameter and 2m deep. They will consist of 1m of concrete reinforced with steel into which is embedded a 2.3m high steel cylinder or bolt ring. The concrete is then covered with 1m of crushed stone leaving the top of the cylinder or bolt protruding 30cm above ground level. The bottom section of the turbine tower is then bolted onto a flange at the top of the cylinder. The 22 crane pad areas will comprise of level hardcore hard-standing areas of 40m X 26m each.

7.4.2 Mitigation measures

During the construction phase, any excavations will be backfilled as soon as is possible to prevent any infiltration of potentially polluting compounds to the subsurface and the aquifer. Any wastewater from the construction facilities on the site will be stored for removal off site for subsequent treatment and disposal. A geotechnical analysis will be carried out for each turbine base into the method of excavation. It is considered, by the geotechnical engineer who assessed the site, that the site is geologically and geotechnically and hydrologically stable and that the construction of the turbines and the construction and retention of the access roads will not affect the drainage of the site. As such it is considered unlikely that land slippages will occur as the site is characterised by shallow soils underlain by bedrock consisting of siltstone or hard shale. More mitigation measures are detailed in Chapter 14: Geotechnical Impact Assessment.

During the construction phase, excavation of the soils in the localised area around the turbine locations and new access roads will be kept to a minimum, to ensure minimal disturbance of the natural soil conditions.

7.4.3 Cabling areas

Cables will be laid underground in trenches approximately 1.2m deep, between the turbines and from the turbines to the proposed substation compound.

7.5 HEALTH AND SAFELY

The wind farm will be designed, constructed, operated and decommissioned in accordance with the Safety, Health & Welfare at Work (Construction) Regulations 2006. Different stages of the development will present health and safety issues.

7.5.1 Construction Health and Safety

- Machinery on site
- Traffic safety during the transport of oversized loads to the site
- Lifting of heavy loads overhead using cranes
- Working with electricity during commissioning
- Working at heights
- General construction site safety

These issues will be covered comprehensively in a safety statement, which will cover all aspects of the construction process.

7.5.2 Operational Health and Safety

During operation, under normal circumstances, there is no danger to people or animals on a wind farm site. There will be no fences around the turbines and the farm boundary fences and gateways will be maintained. Access to the turbines is gained through a door at the base of the tower. This will be locked at all times when unattended. The substation compound will also be securely locked and fenced.

The components of a wind turbine are designed to last 25 years and are equipped with a number of safety devices to ensure safe operation during their lifetime.

Modern turbines have two independent fail-safe mechanisms to stop the turbine. The aerodynamic breaking system is the main braking system, with mechanical brakes as a backup system. This is additional to the yawing and blade pitch mechanisms, which protect the blades from very strong winds by turning and allowing the wind to flow over the blades with least resistance. At the design stage the blades are tested statically by applying weight to bend the blades and dynamically by testing the blades ability to withstand fatigue from repeated bending (more than 5 million times).

The rigorous safety checks imposed on the turbines during design, construction and commissioning should ensure that the risks to humans will be negligible. The health and safety record of the wind industry internationally is exceptionally good. The operation of a wind farm has practically no potential for severe accidents to the general public.

Regular safety audits of control measures in place on the site will be conducted during the operational phase to ensure that these control measures are effective at reducing risk to persons and property.

7.6 EMPLOYMENT

7.6.1 Employment in the Industry

The renewable energy sector generates more jobs per MW of power installed, per unit of energy produced and per euro of investment, than the fossil fuel energy sector. Industrial and craft jobs are created right through from manufacture and production to installation and maintenance. Approx. 60% of these jobs are in the turbine and component manufacturing sector and 40% are in promotion, construction engineering, project management, legal, accounting and financial services. Wind energy companies in the EU currently employ 108,600 people; when indirect jobs are taken into account this figure rises to more than 180,000.

7.6.2 National Employment and Benefits

Over 1,500 people are employed directly in wind energy companies in Ireland. The development at Upperchurch will boost direct and indirect employment in Ireland. European Wind Energy Association analysis concludes that 15.1 temporary jobs are created in the EU for each new MW installed. Approx. 40% of these jobs are created in the country where the turbines are installed. This equates to 277 jobs in Ireland, during the development, planning, construction and commissioning of the 22 proposed turbines. In addition, 0.4 jobs are created per MW of total installed capacity in a country in operation and maintenance, legal, sales, asset management and other activities related to existing installations. This equates to 8 jobs related to the operation of the turbines at Upperchurch Windfarm.

In summary the jobs and opportunities that will be created both during the construction and the operation phase of 22 turbines at Upperchurch windfarm are:-

- 8 permanent jobs operation and maintenance, legal, electricity sales, asset management
- 277 temporary jobs in civil and electrical construction companies, legal and accountancy firms, financial services sector, insurance sector, quarry and stone suppliers and project management.
- €20 million will be spent in Ireland on the civil and electrical contracts
- General activity on the site will increase business in the local service industry i.e. accommodation and restaurants for a period of 8 months.
- There will be increased orders at local concrete plants and quarries.
- Commercial Rates will be paid annually to the Local Authority.
- Annual rental payments to 37 landowners
- Annual community benefit payment

7.7 CONCLUSION

There will be short term and long term consequences, in the Upperchurch area, due to the construction and operation of the proposed turbines.

The construction phase will boost jobs locally in contracting, services and labouring. There will, however, be more disruption on local roads due to construction traffic. The construction of the turbines presents no concerns with regard to human safety or environmental protection issues.

The operational phase will provide work and experience for companies in the region who wish to get involved in the growing wind industry and a long-term rental income for 37 landowners, 35 of whom live locally and an income for the Local Authority area in the form of commercial rates.

FIGURE 7-1: TURBINE COMPONENTS HAUL ROUTE

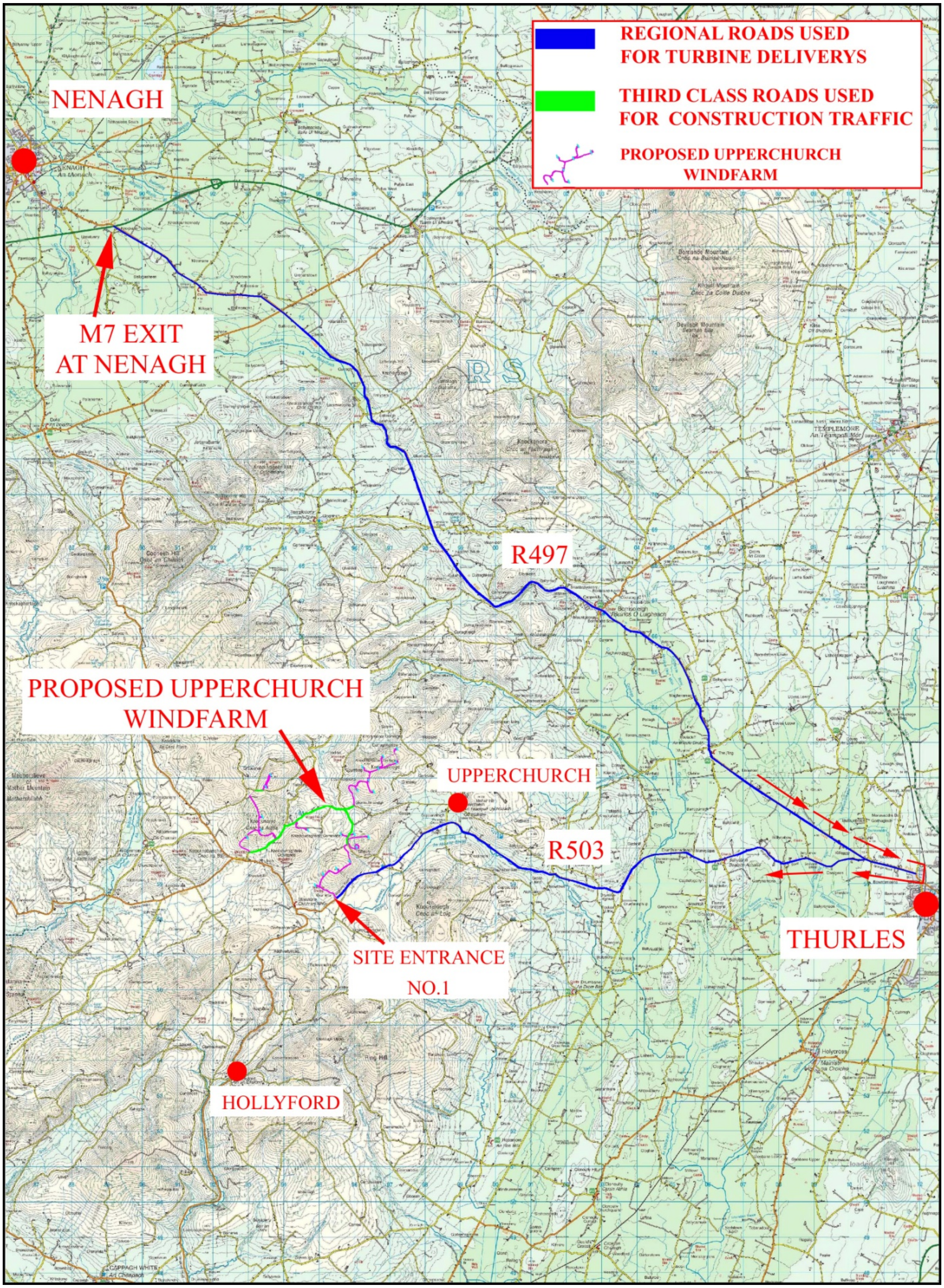


FIGURE 7-2: LOCATIONS OF SITE ENTRANCES

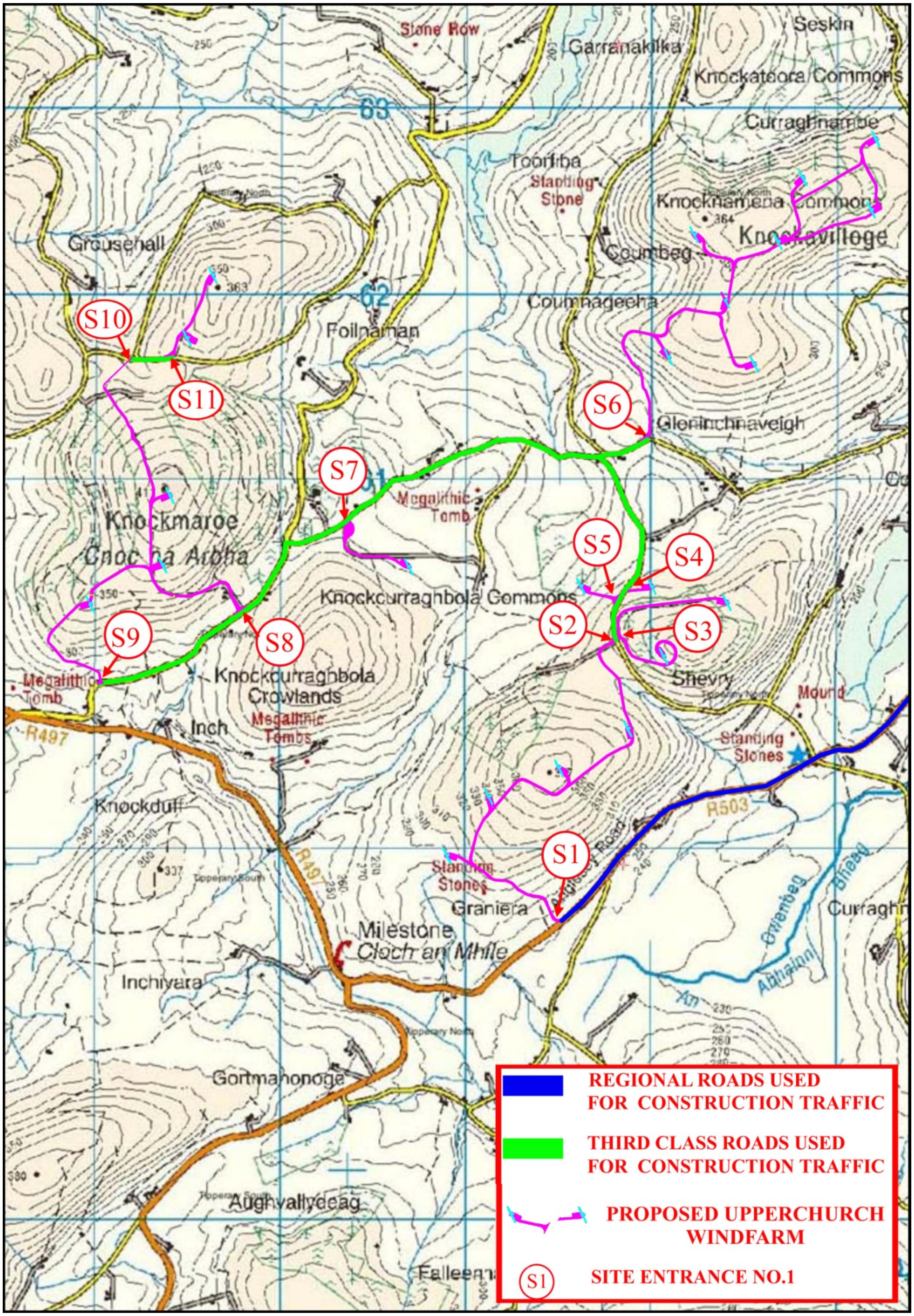
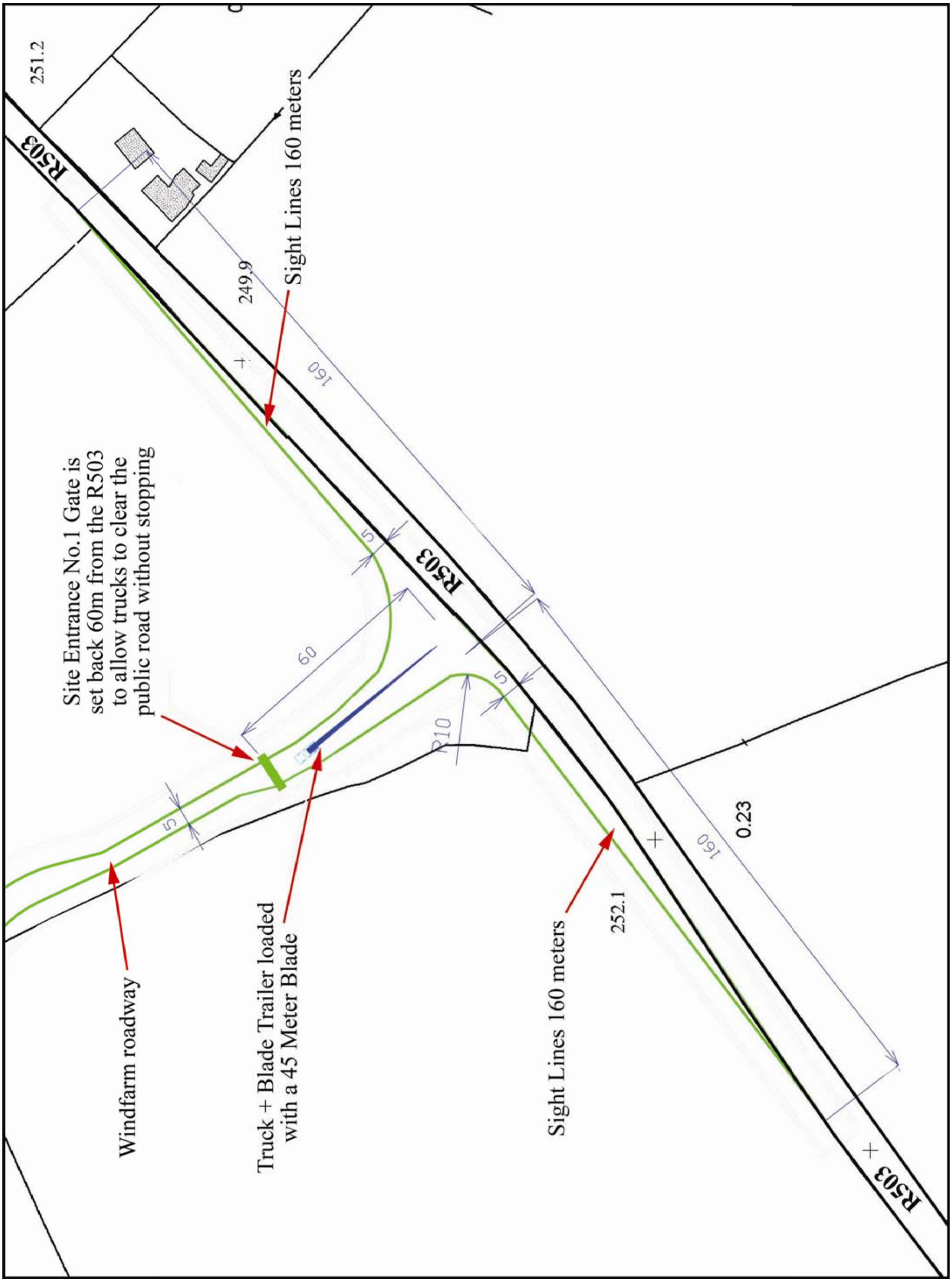


FIGURE 7-3: SITE ENTRANCE NO.1



Upperchurch Windfarm Environmental Impact Statement

8 Air & Climate Impact Assessment

8.1 THE EXISTING ENVIRONMENT

Given the site's rural setting, existing air quality in the locality is typically regarded as good. With the exception of local traffic, agricultural activities and domestic fuel combustion, no fugitive or point sources of emission have been identified that significantly compromise the existing air quality.

8.2 SIGNIFICANT IMPACTS OF THE PROPOSAL

No air-polluting emissions arise during the operational phase of a wind farm. Any potential adverse impact on air quality as a result of the development will principally be confined to the construction phase of the development. The potential air pollutants as a result of the proposed wind farm development constitutes (i) site machinery and vehicle exhaust emissions (NO_X, SO_X, CO_2 etc) resulting from transportation and installation of turbines and (ii) dust emissions as a result of foundation excavation, internal road construction and turbine transportation.

Of the aforementioned, the most notable emission likely to arise from the development during this phase would be an increase in dust concentrations. It is considered that only minute quantities of air pollutants would be emitted from development related vehicle traffic and machinery.

8.2.1 Effects on Air Quality during Construction

During the construction phase of the development, site preparation works namely the removal of topsoil, the construction of internal on-site roads and excavation works for turbine foundations are likely to contribute to minor point and fugitive emissions of dust particles in the area. Turbine haulage trucks are also likely to contribute minor fugitive emissions of dust due to movement of trucks on unpaved surfaced internal haul roads and/or are likely to re-suspend dust when travelling the local road networks.

Generally the greatest proportion of dust generated is likely to have a particle size in excess of 30 microns, which will generally deposit within 100m of the dust sources. Intermediate sized particles (10 – 30 microns) may circulate 200m-500m, while small particles (<10 microns) will travel greater distances. Meteorological data indicates that the prevailing wind originates from the southwest direction. This indicates that the main direction of dust dispersion will be to the north, northeast and east of the sites.

Generally speaking the dust created by the above works is principally considered non-hazardous nuisance dust. As regards effects on agricultural lands and vegetation, no significant impact on livestock, soil structure, or flora would be expected due to the duration of the works involved. In consideration of neighbouring residences, particularly those residence to the north, northeast and east, the distances involved from site works will mitigate any significant impact relating to dust nuisance.

Given the limited time period for construction there is unlikely to be any quantifiable or lasting negative effects on air quality from dust emissions. Thus the effect on air quality is considered to be of minor temporary significance.

8.2.2 Effects on Air Quality during Operation

Wind energy is among the cleanest energy source available. It is safe, renewable and completely non-polluting in the operational phase. Wind is in abundant supply and there are no emissions from the energy production phase of a wind farm. During the operational phase there is a positive net environmental impact associated with wind farm developments. There is a reduction in the need for the production of electricity from non-renewable sources, such as the burning of fossil fuels and nuclear energy, as a result of the production of electricity from wind power. Non-renewable sources of electricity production all have major significant negative environmental impacts.

The proposed turbines are predicted to produce approximately 150 million kilowatt hours (kWh) of clean electricity per annum.

8.3 MITIGATION MEASURES

8.3.1 Construction Phase

Dust arising during the construction phase of the wind farm development due to a prolonged dry spell would be regarded as an unavoidable nuisance. In this eventuality it is desirable that the amount of dust arising be kept to a minimum so as to minimise effects on air quality in the locality. Mitigation measures to minimise the concentration of dust generated during construction of the development includes the selection of construction materials for the onsite road network so as to ensure that particles are not blown around the site, this includes the use of aggregate of not less than 5mm grade and to also ensure that surface dressing be compressed quickly. In addition to reduce impacts on air quality concrete brought to the site will be poured directly, haulage trucks will not be over filled and also that site machinery and vehicles onsite will not be left running unnecessarily. More than one third of the turbine access roads already exist as forestry/farm tracks and although these will require up-grading the limited new access roads that will be required mitigates construction traffic considerably.

8.3.2 Operational phase

During the operational phase of the wind farm the implementation of mitigation measures is not necessary, as only positive impacts on air and climate are associated with this stage of the development.

REFERENCE DOCUMENTS

Upperchurch Windfarm Environmental Impact Statement

9 Socio-Economic Impact Assessment

9.1 INTRODUCTION

A demographic, social and economic profile of the area was conducted to assess the impact of constructing a windfarm in the area.

9.2 THE EXISTING ENVIRONMENT

9.2.1 The Site

The windfarm is proposed for an area within a series of small hills, 2km west of Upperchurch village and 18km to the west of Thurles, County Tipperary. It lies just north of the main road between Limerick and Thurles, which dissects the mountains from west to east. The village of Milestone is immediately to the south-west. The site is located in the townlands of Graniera, Shevry, Knockcurraghbola Commons, Gleninchnaveigh, Coumnageeha, Knocknamena Commons, Knockmaroe and Grousehall. The turbines are set out generally over four areas, to the north east, the south east, the west and an area in the centre of the site. The landcover in the area comprises predominantly pasture fields, forestry and frequent areas of bog/reeds. The area is rural with a dispersed and low population.

9.2.2 Settlement & Population

Overall the area is very sparsely populated with settlement patterns in the study region typically comprising very small community settlements to relatively isolated farmlands. Settlements are essentially single individual dwellings dotted along the third class routes that service the locality or are located along cul-de-sacs.

The nearest Local Service Centre is the village of Upperchurch located 2km to the east of the site boundary. Upperchurch is served by a network of local roads, the R503 linking Newport to Thurles lies just to the south of the village. Upperchurch is serviced by a public water supply, waste water treatment plant, a post office, Church, public houses, community centre and creche, community welfare centre, school and graveyard. It also a technology centre, Uplands IT which is located in the primary school grounds.

The village of Kilcommon lies 3km to the west of the site boundary, mid-way between Thurles and Newport. Kilcommon forms two distinct parts, namely Kilcommon Upper which is located c. 1.25km north of the regional road R503 and Kilcommon Lower which is located at the junction with the regional road R-503. The settlement is serviced by a public water supply and is well connected to Thurles via the R503 and to Nenagh via the R497. The upper village provides a range of services including two pubs, school, church, graveyard and community hall. The lower village is defined by a cluster of development consisting of a pub/shop, private housing and playing pitch. The village also enjoys the benefit of a prayer garden and a picnic area near the Bilboa river.

The nearest District Service Centre is Newport which is 22km to the west. The nearest Secondary Service centre is Borrisoleigh which is 8km to the north east. The nearest Primary

Service Centre is Thurles which is 18km to the east. There is good access to the site area from Newport to the west and Thurles to the east on Regional Road; R503.

The site of the proposed windfarm is in the townlands of Graniera, Shevry, Knockcurraghbola Commons, Gleninchnaveigh, Coumnageeha, Knocknamena Commons, Knockmaroe and Grousehall which are in Electoral Divisions Foilnaman and Upperchurch. Population statistics for these EDs are given below in Table 1

Table 1: Area Statistics

E.D	DED Population 2011	No. of Households
Foilnaman	332	122
Upperchurch	329	114

Source*: CSO Census 2011- Small Area Population Statistics*

In Upperchurch and Foilnamon ED areas 42% of the total population are in employment;in agriculture and forestry activity being the biggest occupation followed by professional services.

In Upperchurch and Foilnamon, 172 males are employed in the following sectors; agriculture and forestry at 34%, manufacturing industry at 16%, commerce and trade at 13%, public administration and professional at 8% each and building and construction at 6%.

In Upperchurch and Foilnamon, 110 females are employed mainly in the following sectors: professional services 45%, commerce and trade 15%, public administration 11%, manufacturing industry 9% and agriculture and forestry 7%.

9.2.3 Agriculture and Forestry in North Tipperary

Agriculture is the predominant land-use in North Tipperary with 149,411 ha of land under agriculture. Of this, 12,322 ha are under tillage for crops, fruit and horticulture. A further 130,371 ha are used for hay, silage and pasture. The most important activity is dairying and cattle rearing with over 80% of the agricultural gross output being generated by these sectors. Sheep account for c.136,000 animals in the County. There are approximately 26,000 ha of land taken up by forestry. Coillte own over 75% of the forestry land in the County while the remaining 25% is in private ownership.

The pre-dominant agricultural activity in the area is cattle rearing, dairying and forestry with some sheep rearing also.

9.2.4 Industry

While the County has a varied and diverse economic structure, economic activity is largely centred in urban centres although there is an increasing amount of economic activity locating in villages and the open countryside. Industrial activities in the study area are not intensive and essentially comprise of small local indigenous and micro enterprises.

9.2.5 Education

The Tipperary Institute in Thurles, now LIT Tipperary having joined forces with Limerick Institute of Technology, provides third level education in the County via a multimodal model. The Institute also has strong community links and targeted links with industry. The multi-nodal locations include both Thurles and Clonmel and links with secondary schools and the University of Limerick. There is also a Regional Training Centre in Roscrea.

LIT Tipperary located is 18km to the west of the study area and has promoted education through full time and part-time 3rd level courses in renewable energy since its inception in 1999. LIT Tipperary hosted a successful energy week as recently as October 2012 in recognition that many countries, including Ireland, are looking to green growth as the way out of the current economic crisis. LIT Tipperary offers a range of renewable energy courses in the context, to quote their website, of *government reports suggesting that there is the potential to create over 80,000 jobs in the 'Green Economy' (Developing the Green Economy in Ireland, 2009) and that there are currently at least 6,500 people employed directly in the environment sector in Ireland and the potential to create over 50,000 direct jobs by 2020 (Forfás, 2009).* LIT Tipperary offers full time undergraduate courses relevant to the Green Economy including Certificate in Renewable Energy Development, BSc in Environmental & Natural Resource Management and BSc in Computing, Smart Energy Systems.

The development of a large windfarm using the most uptodate technology and computer systems in windfarm management, close to LIT Tipperary will be a realisation of one the aims of the Institute to facilitate the promotion of the Green Economy.

9.2.6 Tourism

Although tourist visits to North Tipperary have increased in the past 15 years, the number of tourists represents only 5.4% of total visitors to Ireland.

North Tipperary has the longest shoreline of Lough Derg and provides some of the most striking views of the area from the Arra Mountains east of the lake. Ballina, Portroe, Garrykennedy, Dromineer and Terryglass are the centres for tourism around Lough Derg. The area is the most important tourism offering in the county, focusing on water and marine based activities as well as shore side activities including jetties and marinas.

The rural environment of North Tipperary provides an increasingly important location for water based, forestry based, agri-tourism and heritage based recreation to an increasing number of urban dwellers both from Tipperary and outside of the county.

Recreational offerings in the immediate environs of the proposal include a prayer garden and picnic area based in Kilcommon village and a walking festival weekend based in Upperchurch village.

The Walking Festival, held in November and in it's 3rd year, promotes walks of various levels of difficulty in a programme of events from Friday to Sunday in the hills around Upperchurch village including three National Loop Walks - Knockalough Red Hugh Walk, Birchill Loop Walk and Slí Éamoin an Chnoic Walk. The Kilcommon Pilgrim Trail is also a national loop walk and features in the Upperchurch Walking Festival also. There are also 3 cycling events leaving from Upperchurch, offered in the programme of activities.

9.3 LIKELY SIGNIFICANT IMPACTS

Nationally the impacts of wind farm developments are largely beneficial. The generation of electricity from this renewable source will avoid the cost of importation of fossil fuels that would otherwise be required to generate the equivalent amount of electricity and will contribute to security of supply. However impacts at local level are typically more complex. Implications associated with the proposed wind farm development which may affect the local human environment are discussed hereunder. Please note that issues concerning noise and health and safety are principally addressed within other sections of the E.I.S. document (Chapters 7 & 10).

9.3.1 Construction Impacts

As with any development initial construction activities will pose temporary minor disturbances locally. The most notable of these disturbances relates to the generation of additional traffic on the local road networks. Given the nature of the vehicles required for turbine transportation in relation to the local road infrastructure it is likely that local residents and users of these roadways will experience minor disturbance from turbine related traffic. Here noise and safety implications are also an issue. However all disturbances associated with the additional volumes of traffic will be confined to the construction phase. Thus impacts are considered of temporary significance.

9.3.2 Operational Impacts

There are no major adverse operational impacts associated with the proposed wind farm development which would significantly impact negatively on local society. The project will produce electricity in an environment-friendly manner thereby avoiding the risk of air pollution and thus risk to human health. Noise emissions will not adversely impact on the quality of life of local residents.

The visual element of the development is perhaps the most pertinent aspect. Given the size of the turbine structures a visual consequence is unavoidable. The extent of visual impact will vary in degree and significance according to viewing distance, the numbers and parts of turbines visible, the local topography and public perception. Please refer to Chapter 11 of the EIS for the Visual Impact assessment.

The windfarm will be visible to a greater or lesser extent from the Loop walks and cycling events that comprise the Upperchurch Walking Festival. These events have been discussed with local community representatives and ideas were shared on how the windfarm infrastructure can be used to enhance the programme of activities.

The community in the area will gain from the significant rental payments which will be paid annually to 35 local landowners. The wider community will gain through a direct payment to the local community development groups.

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9.3.3 Land-use

In an area dominated by agricultural land: the pattern of land use on the site will not change significantly as a result of the proposed wind farm. Only approx 2% of the total land area of a site is used for the turbines and roads associated with the wind farm development. The remaining land is available for use as before. Wind turbine foundations are normally completely buried, permitting existing agricultural activities to extend right up to the tower base. The proposed development will therefore be compatible with the current agricultural practices on the site. Thus the ability for the site to sustain current agricultural practices in conjunction with the proposed wind turbines greatly enhances the economic land-use viability of the 37 individual farms involved in the project.

9.3.4 Property value

Land and property value may be economic or amenity in nature.

The land on which the turbines are positioned will increase in value because of the lease income from the development.

The potential for the proposed development to devalue neighbouring lands is mitigated by the EDP policy requirement to maintain a distance of 1.5X the turbine height from the boundaries of neighbouring lands. In all cases where this distance is not achieved it is with the permission of the neighbouring landowner.

Impact on existing residential property in its vicinity is essentially dependent upon public perception of the development and perceived associated impacts. Personal disposition regarding visual impact is the only likely significant implication with regard to residential values.

The windfarm development will not cause any material damage to neighbouring lands or residences and does not pose any polluting or hazardous threat that would result in the devaluation of neighbouring properties.

9.4 MITIGATION & RECOMMENDATION

In the interest of road safety during the construction stage, measures regarding traffic control will be implemented. In order to mitigate for increased road usage, deliveries of heavy equipment will be timed to cause minimal disturbances to the residents and users of the local roads. Road authorities will also be informed of the planned road use.

10. RESIDENTIAL AMENITY

10.1. INTRODUCTION

The construction of wind turbines has the potential to impact on nearby residential amenity with regard to shadow flicker effect and noise.

Irish Wind Energy Association Best Practice Guidelines recommend that the predicted noise and shadow flicker effects are assessed for houses up to 10 rotor diameters from the nearest turbine. For the purposes of this EIS all houses within 900m of a proposed turbine are assessed.

There are 93 houses within 900m of a proposed turbine. The nearest house is 385m from a proposed turbine and is owned by one of the site owners but is unoccupied. The nearest house which is occupied by a person that is not involved in the project is 446m from a proposed turbine.

These houses are numbered 1-93 on **Figure 10.1** Shadow Flicker Effect Map and Chapter 10, Appendix 1 **Figure 2** Predicted Noise Levels at the end of this Chapter.

Shadow flicker is assessed below at 10.2. Noise Impacts are assessed separately by Malachy Walsh and Partners, Environmental Engineers in Appendix I of this Chapter.

10.2. SHADOW FLICKER

Wind turbines can cast long shadows when the sun is low in the sky. Where the blades of a wind turbine cast a shadow over a window in a nearby house and the rotation of the blades causes the shadow to flick on and off this occurrence is known as shadow flicker. This effect lasts only for a short period and happens only when the 7 specific circumstances listed below ***combine***:

1. the sun is shining *and*
2. The sun is at a low angle (after dawn and before sunset), *and*
3. the turbine is directly between the sun and the affected property, *and*
4. there is enough wind to ensure that the turbine blades are moving *and*
5. the turbines are directly facing onto or away from the window, *and*
6. there is a window on the wind-turbine side of the house, *and*
7. there is no screening from vegetation

Note: The turbine blades are electronically directed to track the wind. The 3 blades then turn automatically to face the wind. For the turbines to face directly onto or away from a given property the wind would need to be blowing directly towards or away from the same property.

The DoEHLG Wind Energy Guidelines recommended that

> *shadow flicker at neighbouring dwellings within 500m should not exceed 30 hours per year or 30 minutes per day. It is recognised that at distances greater than 10 rotor diameters from a turbine, the potential for shadow flicker is very low. Where shadow flicker could be a problem, developers should provide calculations to quantify the effect.*

When computer modelling to assess the predicted period of shadow flicker effect of the proposed turbines on Houses 1-93 was carried out the module created a 'shadow flicker effect at specified sensitive receptors' occurrence map in which the location and profile of the proposed turbines is recorded along with the nearest sensitive receptors i.e. all houses within 900m of a proposed turbine. It should be noted that this map (Figure 10.1) and data summary (below) presents the 'worse case' scenario as the neither probability of the sun not shining or the turbine not facing the house is taken into account when calculating the Shadow Flicker Occurrence. For example for every hour calculated by the model as having a shadow flicker effect, the actual periods of shadow flicker experienced at a particular receptor may be much less, given the cloudy weather conditions prevalent in Ireland and the variety of wind directions experienced in Ireland.

There are 93 houses (Houses 1-93 on **Figure 10.1**) within 900m of the proposed turbines. The result for the cumulative impact, in hours per year of shadow flicker effect of all 22 proposed turbines on Houses No. 1-93 and are listed below in Table 1.

10.2.1. Shadow Flicker Data

The following table summarises the shadow flicker effect at each of the 93 No. houses within 900m of a proposed turbine. The house number corresponding to the numbering on **Figure 10.1** is shown in column one and the cumulative hours from all 22 turbines is shown in column two.

Table 1: Shadow Flicker Data for Figure 10.1

House No.	Total Hours of predicted shadow flicker effect	Distance to nearest turbine (m)
1	38	471
2	27	385
3	40	460
4	35	494
5	0	502
6	0	457
7	25	503
8	6	442
9	37	516
10	37	474
11	4	513
12	16	600
13	19	528
14	0	519
15	12	533
16	24	524
17	0	514
18	19	396
19	23	541

House No.	Total Hours of predicted shadow flicker effect	Distance to nearest turbine (m)
20	27	549
21	0	535
22	0	551
23	9	559
24	26	528
25	10	446
26	5	608
27	0	544
28	11	582
29	0	533
30	0	591
31	0	594
32	24	609
33	52	598
34	0	610
35	1	602
36	0	617
37	0	558
38	0	585
39	0	620
40	13	613
41	10	633
42	0	824
43	8	629
44	4	633
45	15	630
46	7	643
47	7	651
48	9	668
49	21	652
50	0	602
51	0	680
52	16	595
53	7	648
54	1	553
55	9	625
56	0	693

House No.	Total Hours of predicted shadow flicker effect	Distance to nearest turbine (m)
57	0	694
58	0	646
59	0	689
60	0	635
61	0	641
62	16	508
63	0	706
64	5	707
65	1	643
66	0	647
67	0	651
68	0	723
69	0	729
70	0	744
71	0	759
72	0	717
73	4	566
74	0	770
75	1	779
76	5	580
77	4	749
78	0	762
79	0	800
80	0	821
81	0	761
82	0	833
83	0	769
84	0	838
85	0	815
86	0	842
87	0	781
88	0	860
89	0	864
90	0	782
91	0	666
92	0	885
93	0	861

10.2.2. Shadow Flicker Assessment Results

The DOEHLG Wind Energy Guidelines state that shadow flicker at neighbouring dwellings within 500m should not exceed 30 hours per year. At distances greater than 500m the effect is dissipated and at distances greater than 10 rotor diameters the potential for shadow flicker is very low.

Table 1 lists the results of the Shadow Flicker Occurrence model. Shadow flicker is predicted to exceed 30 hours per annum at 6 of the 93 houses surveyed, 4 of which are within 500m of a turbine. The House number as per Table 1 above and Figure 10.1 (Column 1), hours of shadow flicker occurrence from specific turbines (Column 2) and hours of cumulative shadow flicker occurrence per annum. values (Column 3) are listed. Mitigating factors for each house are also listed (Column 4).

Table 2: Shadow Flicker > 30 hours per annum

1	2		3	4
House No.	**Turbine No.**	**Hours**	**Total hours per annum assuming sunshine 100% of the time**	**Mitigating factors**
1	T21	38	38	471m from T21 Landowner involved in the project Fully screened by trees in the direction of the turbine
3	T21	40	40	460m from T21 Fully screened by trees in the direction of the turbine
4	T11 T12	1 34	35	494m from T12 Fully screened by trees in the direction of the turbine
9	T6 T7	28 9	37	516m from T6 Landowner involved in the project House is partially screened by trees Over 500m from nearest turbine
10	T21	37	37	474m from T21 Fully screened by trees in the direction of the turbine
33	T9 T11 T12	3 2 47	52	600m from T12 House is partially screened by tall trees in the direction of the turbines Over 500m from nearest turbine

Note: The wind would need to blow 100% of the time from critical wind directions and the sun would need to shine for 100% of this time for the predicted shadow flicker effect hours to be achieved. In reality, when these constraints are taken into account, the actual shadow flicker hours will be much less than predicted.

10.2.3. Mitigation Measures

Predicted durations will apply only if there is a coincidence of the sun shining at a very low angle, the turbine blade set is turned towards the property, the property has a window facing the turbine, there is no intervening vegetation or building and the turbine blades are moving. In other words shadow flicker can only occur if the sun is shining, the sun is low in the sky, the wind is blowing towards or away from the house and there is nothing obstructing the view of the turbine.

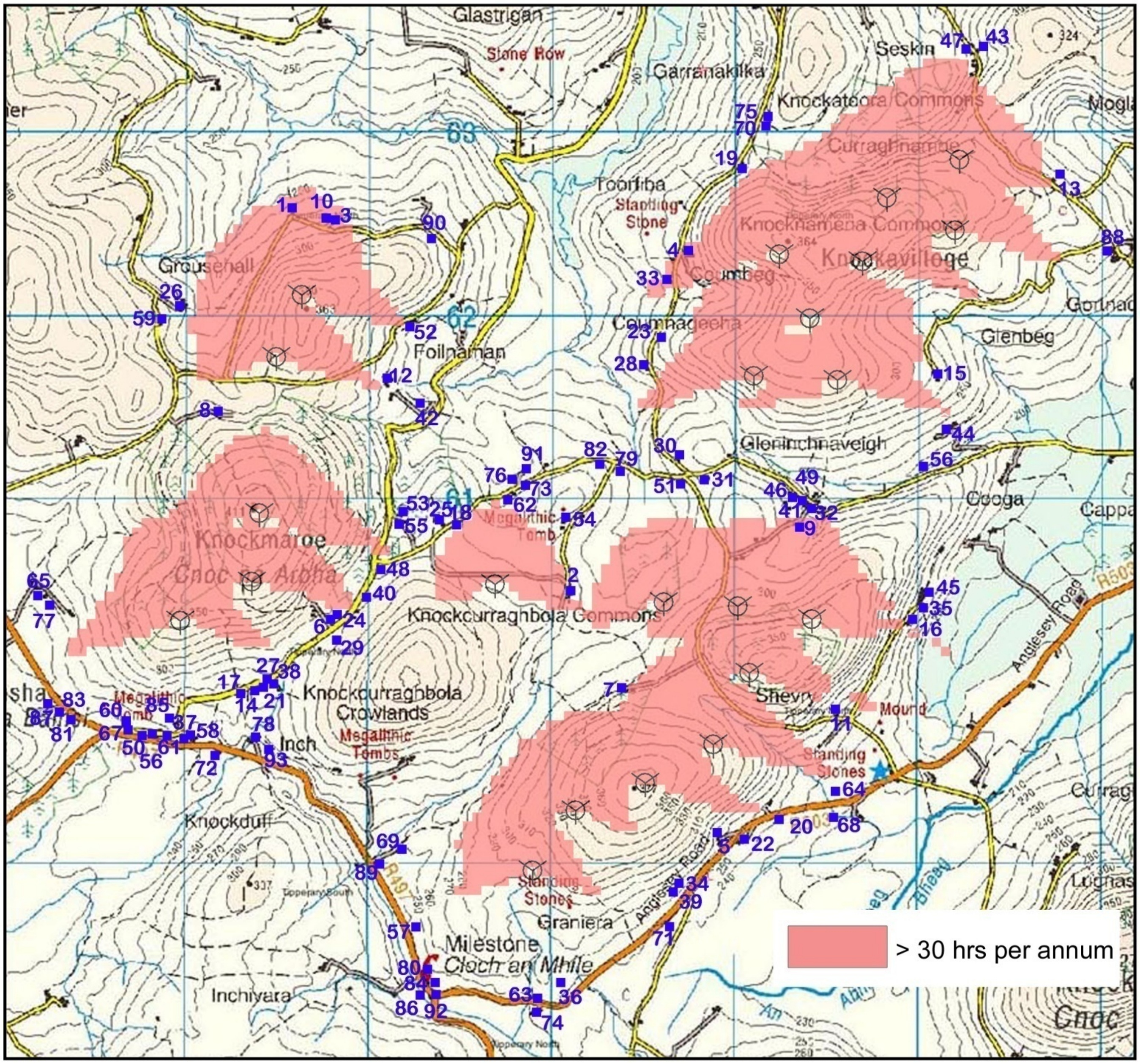
According to Met Eireann data the sun shines for an average of between 28% and 40% of the time in Ireland and even using the conservative 40% value, shadow flicker occurrence will not exceed 30 hours per annum. at any house surveyed.

In addition, shadow flicker effect is ameliorated by distance. For the turbines proposed for Upperchurch, which are standard turbines consisting of a tower topped by a set of three tapered blades mounted on the horizontal axis it is conservatively assumed that there will be negligible effect for distances greater that 1,000 meters and only a partial effect between 400 meters and 1,000 metres.

The angular diameter of the sun is about 0.54^0 based on a diameter of 1.4×10^6 km at a distance of 1.49×10^8 km. This will affect the extent of time that the shadow effect occurs at any location and the nature of the effect. At close distance, a blade may have a noticeable shadowing effect, but the extent of the effect will decrease with distance. For example, a 3.5m wide blade would need to be at a distance of only 375m to have the same angular width as the sun. Even at 375m the effect of atmospheric scattering of light is likely to mean that the shadow effect is not clearly defined. Beyond 375m the turbine blade is less than the angular width of the sun. In this situation, the shadow flicker effect may be considerably reduced in intensity.

Ecopower Developments intend, for the first two years of operation, to log in real time the actual shadow flicker duration at the six dwellings listed at Table 2 above to ensure that the effect will not exceed 30 hours per annum. In the unlikely event that it is found that the 30 hours per annum limit will be exceeded, the offending turbine will be shut down during the time that it would cause the effect at the particular dwelling in question for the remaining part of that year.

FIGURE 10-1: SHADOW FLICKER EFFECT MAP



APPENDIX 10-I NOISE IMPACT ASSESSMENT

Malachy Walsh and Partners
Engineering and Environmental Consultants

Appendix 10-I
Upperchurch Wind Farm

Noise Impact Assessment

14802

October 2012

EcoPower Developments

Job number	Revision	Prepared by	Checked by	Status	Date
14802-6001	A	Peter Barry		Client Review	07/09/2012
14802-6001	B	Peter Barry		Client Review	12/10/2012
14802-6001	C	Peter Barry		Client Review	06/12/2012

Peter Barry, BSc, MSc, PGDip (Air Quality, Noise and Vibration, Waste Management) is an Environmental Consultant with six years experience across a wide range of environmental projects, including EIA, contaminated land site investigations, waste management, environmental monitoring and air quality and noise and vibration assessment. Peter has completed many air quality and noise assessments for inclusion in Environmental Reports and Environmental Impact Statements.

1 INTRODUCTION

This chapter describes the potential noise and vibration associated with the construction and operation of the proposed Upperchurch wind farm.

The main sources of noise from a wind turbine include aerodynamic noise (rotating blades in the air) and mechanical noise (gearbox (if not a direct drive system) and generator).

Noise only occurs above the 'cut-in' wind speed and below the 'cut-out' wind speed. The typical 'cut-in' wind speed of a modern turbine is 3 meters per second (m/s) and the 'cut-out' wind speed is approximately 25 to 30 m/s. At this stage of the proposal the preferred turbine candidates has not yet been finalised. For the purpose of this assessment the sound power levels and octave banding associated with the Vestas V90 turbine were used. Ultimately the most appropriate turbine model and operating will be selected in order to achieve the noise limits set down in any planning condition.

Construction noise will occur during excavation and earth moving, laying of roads and hard standings, transportation of materials and erection of the wind turbines. The construction phase will be phased and temporary.

Aerodynamic Modulation, Infrasound, Wind Farm Noise on Health and Vibration associated with wind turbines have also been addressed in this report.

2 METHODOLOGY AND ASSESSMENT CRITERIA

In general the methodology used to assess the noise impact from wind farms includes extended measurements of the existing background noise levels (across a range of wind speeds) at nearby representative dwellings and comparisons against the predicted noise output from the wind farm, which also varies with wind speed. The methodology and planning guidance framework are described in the following sections.

2.1 WIND FARM NOISE PLANNING GUIDANCE

a) ETSU-R-97 – The Assessment and Rating of Wind Farm Noise (1997)

The assessment methodology was adopted from *ETSU-R-97 – The Assessment and Rating of Wind Farm Noise (1997)*[1]. This document is currently used as the industry standard in the UK and Ireland and the noise levels contained within the Irish Wind Energy Planning Guidelines are adapted from this document.

b) IoA Acoustics Bulletin Article, Prediction and Assessment of Wind Turbine Noise, March/ April 2009

The Institute of Acoustics Bulletin Vol. 34 no 2 contains an agreement, jointly authored by a number of consultants working in the wind turbine sector for developers, local authorities and third parties, on an agreed methodology for addressing issues not covered by ETSU-R-97. This includes a methodology for dealing with wind shear and an agreed method for noise predictions.

c) Department of the Environment, Heritage, and Local Government (DoEHLG) – Wind Energy Planning Guidelines (Department of the Environment, Heritage and Local Government 2006)

This document provides the framework for wind farm noise assessment in Ireland. It is evident that the assessment criteria in this document are adapted from *ETSU-R-97 – The Assessment and Rating of Wind Farm Noise (1997)*.

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[1] A recent research report published by Hayes McKenzie reviewed the way noise assessments are being carried out as part of the application process for planning consent for wind turbines in England. It was reported that from the sample set reviewed the ETSU-R-97 methodology has been universally adopted for the assessment of noise from proposed wind farm developments with 100% of cases stating it to be the appropriate guidance.

2.1.1 Prevailing Background Noise Levels

For the purpose of this assessment noise monitoring was carried out for period of two weeks at each of the measurement locations between July and August 2012. Given the number of dwellings in the area noise monitoring was undertaken at 10 locations (NM1 to NM10). The monitoring equipment used included:

a) **A Bruel and Kjaer (B&K) 2250 sound level meter** was used to measure background noise levels at the selected receptors. The microphone was mounted on a tripod at least 3m away from any reflective surfaces and at height of 1.2 meters (m). A wind shield was mounted on the microphone. An outdoor environmental noise enclosure protected the equipment from the elements.

b) **A Vantage Pro2 weather station** developed by Davis Instruments was used to monitor wind speeds, wind direction, temperature, humidity and rainfall rate throughout the measurement period. This data was logged in 10 minute intervals which were synchronised with the sound level meters.

Wind speed measurements were recorded at a height of 4m. However, wind speed varies with height above the ground level, increasing with increased height. In accordance with ETSU the values of wind speed were corrected to a height of 10m. Using equation (1) wind speeds measured at one height, can be corrected to the value that would have been measured at another height.

$$\frac{v_1}{v_2} = \frac{\ln\left(\frac{h_1}{z_0}\right)}{\ln\left(\frac{h_2}{z_0}\right)} \qquad (1)$$

where v_1 is the wind speed (m/s) at a height of h_1 meters above ground level,v_2 is the wind speed (m/s) at a height of h_2 meters above ground level, z_0 is the ground roughness length (m) .Some typical values for z_0 are presented in Table 11.2. For the Upperchurch case a roughness length of 0.05 was selected.

Table 1 Roughness length for various types of terrain (ETSU).

Type of Terrain	Roughness length z0
Water area, snow or sand surfaces	0.001m
Open, flat land, mown grass, bare soil	0.01m
Farmland with some vegetation	0.05m
Suburbs, towns, forests, many trees and bushes	0.30m

2.2 POTENTIAL IMPACT

The noise modelling software (Predictor, Version 7.1) is based on ISO 9613-2:1996 Acoustics – *Attenuation of sound during propagation outdoors* – Part 2: General method of calculation. This software was used to predict wind farm noise at all dwellings within 900m of the proposed wind farm. The data input into the model was defined by *IoA Acoustics Bulletin March/April 2009 – Prediction and Assessment of Wind Turbine Noise* and is presented in table 2.

The data used in the model is conservative in particular as it assumes all dwellings are downwind of all turbines simultaneously, which in practice cannot happen. For wind directions other than downwind, noise levels will be lower.

The predicted turbine noise L_{Aeq} has been adjusted by subtracting 2dB(A) to give the equivalent L_{A90} as suggested by ETSU-R-97.

Table 2 Model Input Data

Item	Description
Turbine	Vestas V90
Turbine Locations	GPS Co-ordinates
House Locations	Site Survey/ Geo-Directory Data
Acoustic Emission	Acoustic Specification Document
Hub Height	80m
Topography	Discovery 10m Contours
Ground Factor	Mixed (0.5)[Note 1]
Receptor Height	4m
Wind Direction	Downwind
Relative Humidity	70%
Temperature	10^{o}C

Note 1: The ground factor may be between 0 and 1, were 0 represents hard ground and 1 represents soft ground. Hard ground reflects sound and sot ground absorbs it.

The sound power levels for the Vestas V90, with typical octave band data was obtained from the Vestas Specification Document[2] are outlined in Table 3.

[2] 1/1 Octaves According to General Specification V90-0005-5233 V01

Table 3 Vestas V90 – Octave Banding and Sound Power Levels (SPL)

Wind Speed	Octave Band (Hz)								
	63	125	250	500	1000	2000	4000	8000	SPL dB
10 m/s	91.3	93.0	95.5	98.2	100.4	99.2	94.9	85.0	105.6
9 m/s	92.3	94.2	96.9	99.5	101.7	100.4	96.4	86.6	106.9
8 m/s	91.8	94.0	97.3	99.6	101.8	100.5	96.7	86.7	107.0
7 m/s	89.7	93.3	96.1	98.3	100.8	100.1	96.2	85.7	106.1
6 m/s	85.7	90.9	94.0	96.5	99.1	98.2	94.3	83.7	104.2
5 m/s	82.1	86.9	91.5	93.5	95.9	94.6	90.5	79.1	100.9

2.2.1 Noise limits and Assessment Criteria

The noise limits applied to the nearest dwellings were adopted from the Department of the Environment Heritage and Local Government (DoEHLG) – Wind Farm Energy Planning Guidelines.

The impact of the construction works on the local dwellings has also been predicted. The construction works will be of short duration. Higher noise limits apply to the construction works as there must be a compromise between the practicality of construction and the temporary nature of the works.

2.2.1.1 Operational Phase Noise Limits

The limits set out in the Department of the Environment Heritage and Local Government (DoEHLG) – Wind Farm Planning Guidelines were adopted for the purpose of this assessment. The noise limits have been defined as shown in table 4.

Table 4 Day and Night Time Noise Limits

Daytime	Night time
Where the prevailing background noise level is less than 30dB, the greater of 35 - 40dB or plus 5dB above background Or Where the prevailing background noise level is greater than 30dB the noise limits are the greater of 45dB or plus 5dB above background.	the greater of 43dB or plus 5dB above background

For the purpose of this assessment where the prevailing background noise level is less than 30dB, the greater of 40dB L_{A90} or plus 5dB above background has been adopted.

2.2.1.2 Construction Phase Noise Limits

There are no mandatory noise limits for construction noise in Ireland. The most recent revision of BS 5228-1:2009 Code of practice for noise and vibration control on construction and open sites outlines noise thresholds for significant impacts. These are outlined in Table 5.

Table 5 Threshold of significant effect at dwellings

Assessment category and threshold Value Period (L_{Aeq})	Threshold value in decibels (dB)
	Category A
Night time (23.00 – 07.00)	45
Evening and Weekends	55
Daytime (07.00 – 19.00) and Saturdays (07.00-13.00)	65

Table 4 can be used as follows: for the appropriate period (night, evening/weekends or day), the ambient noise level is determined and rounded to the nearest 5 dB. This is then compared with the total noise level, including construction. If the total noise level exceeds the appropriate category value, then a significant effect is deemed to occur.

3 EXISTING ENVIRONMENT

The wind farm is to be developed in a rural area 2 km west of Upperchurch Village, County Tipperary. The main sources of noise in the area and the existing noise environment include traffic on the local and regional road network, agricultural activity and other noise typically associated with a rural location.

The locations (GPS Coordinates) of all dwellings within 900m of the proposed wind farm have been provided by the client, Ecopower Developments. There are approximately 93 dwellings within 900m of the proposed development. In total noise monitoring was undertaken at 10 locations, referred to as N1 to N10. The location of the dwellings, noise monitoring locations and proposed turbines are illustrated on Figure 1.

3.1 DERIVATION OF PREVAILING BACKGROUND NOISE

The variation in background noise level with wind speed was determined by correlating $L_{A90,10min}$ noise measurements taken over a period of time (2 weeks) with the average wind speeds measured over the same 10-minute periods and then fitting a curve to these data. The derived regression line (line of best fit) is the average background noise which occurs under different wind speed conditions. This process was repeated for the day and night time periods. The graphs in Appendix A illustrate the prevailing background noise levels across a range of wind speeds as derived from the two week noise monitoring period at each of the monitoring locations.

3.1.1 Critical Wind Speed

The rate at which wind turbine noise increases with wind speed is lower than the rate at which background noise levels increase with wind speed. The impact of wind turbine noise is therefore likely to be greater at low wind speeds, when the difference between the noise of the wind turbine and the background noise is likely to be greater. In accordance with the Irish Wind Farm Planning Guidelines, where the prevailing background noise level is greater than 30dB the noise limits are the greater of 45dB or plus 5dB above background and at **night time -** the greater of 43dB or plus 5dB above background. However the wind farm cannot discriminate between day and night and consequently the lower night time limit of 43dB(A) must apply at all times. Predictions have been undertaken at 8m/s which represents the likely critical wind speed. However noise predictions have been undertaken for all wind speeds for the purpose of comparison against the derived the prevailing background noise levels (see Appendix B).

4 LIKELY SIGNIFICANT IMPACT

4.1 OPERATIONAL PHASE PREDICTED RESULTS

Noise from the wind farm was predicted at all dwellings within 900m with the wind speed at the greatest sound power level to represent worst case scenario conditions. 8m/s wind speed was used because at wind speeds below 8m/s wind turbine noise emission and above 8/s the noise from the wind is likely to mask wind turbine noise.

Table 6 Predicted Worst Case Noise Results (Downwind) @ Maximum Noise Emission (8m/s)

Name	Description	Predicted Noise Level	Predicted Noise Level (with certain turbines in noise reduced mode)	Guideline Limit
H7 **(NM10)**	Unoccupied	45	43	43
H2	Landowner	45	43	43
H5	Landowner	44	42	43
H9	Landowner	44	43	43
H15 **(NM5)**	Landowner	44	43	49*
H41 **(NM4)**	Landowner	43	42	43
H49	Landowner	43	42	43
H32	Unoccupied	43	42	43
H18		43	42	43
H31	Unoccupied	43	42	43
H46	Landowner	44	42	43
H8 **(NM6)**		43	43	49*
H51		43	42	43
H11 **(NM2)**		43	40	43
H54	Landowner	43	41	43

H30		43	42	43
H25		43	41	43
H6 **(NM3)**	Landowner	42	42	43
H23		42	42	43
H4 **(NM8)**		42	42	43
H13 **(NM9)**		42	42	43
H62		42	40	43
H14		42	42	43
H48	Unoccupied	42	41	43
H33		42	42	43
H24	Unoccupied	42	41	43
H12 **(NM7)**	Landowner	41	41	43
H73		41	40	43
H20		42	39	43
H28	Unoccupied	42	41	43
H40	Unoccupied	42	41	43
H34		41	38	43
H39	Landowner	41	38	43
H55		41	39	43
H21		42	41	43
H29		41	41	43
H79		41	40	43
H17		41	41	43
H27		41	41	43
H22	Landowner	41	38	43
H76		41	40	43
H53	Unoccupied	41	40	43
H82		41	40	43
H44		41	40	43
H56	Unoccupied	41	40	43
H52		40	40	43
H38		40	40	43
H70	Community Hall	40	40	43
H3		41	40	43
H75		40	40	43
H26	Landowner	40	40	43
H71		40	38	43
H1 **(NM1)**	Landowner	40	40	43
H10		40	40	43
H19		40	40	43
H42		40	40	43

H64	Landowner	40	37	43
H91		40	39	43
H43		40	40	43
H68	Landowner	40	37	43
H37		40	40	43
H36	Landowner	39	39	43
H47		39	39	43
H59		39	39	43
H16		39	34	43
H50		39	39	43
H69		39	38	43
H58	Landowner	39	39	43
H88		38	38	43
H61		39	38	43
H60		38	38	43
H65		38	38	43
H66	Unoccupied	38	38	43
H63		38	37	43
H35		38	37	43
H78	Landowner	38	38	43
H57		38	38	43
H67		38	38	43
H72	Unoccupied	38	38	43
H45		38	38	43
H74		37	37	43
H93		38	37	43
H77		37	37	43
H90		37	37	43
H85		37	36	43
H81		37	36	43
H80	Unoccupied	36	36	43
H83		36	36	43
H84		36	36	43
H87		36	36	43
H86	Unoccupied	36	35	43
H92	Unoccupied	36	35	43

*5dB(A) above background noise at this wind speed

The results show that the guideline limit may be exceeded at H2 (landowner), H5 (landowner), H7 (empty) and H9 (landowner) with the turbines running in normal operating mode. These results are likely an overestimate as no consideration of wind direction has been factored into the results. The model assumes that all dwellings are downwind of all turbines simultaneously which is practice cannot happen. In reality the contribution of wind turbines to noise levels at local dwellings will be much less under downwind conditions. In addition at all other wind speeds noise levels will be lower. The results in table 6 are illustrated in Figure 2. It must also be noted that these results are based on the turbine running in normal operating mode. Some can turbine types can be run in different operating modes which results in different sound level outputs. The individual turbines will operate in a mode that ensures compliance with the noise limit i.e. 43dB(A).

To demonstrate this, turbines have been modelled in the appropriate mode and the mitigated noise levels are presented in table 6. The turbines operating in noise reduced mode are presented in table 7 below.

Table 7 Mitigated Turbine and Operating Mode

Turbine	Operating Mode
T1	normal operating mode
T2	noise reduced mode 1
T3	noise reduced mode 3
T4	noise reduced mode 2
T5	noise reduced mode 1
T6	noise reduced mode 1
T7	noise reduced mode 1
T8	noise reduced mode 3
T9	normal operating mode
T10	noise reduced mode 1
T11	normal operating mode
T12	normal operating mode
T13	normal operating mode
T14	normal operating mode
T15	normal operating mode
T16	normal operating mode
T17	normal operating mode
T18	normal operating mode
T19	normal operating mode
T20	normal operating mode
T21	normal operating mode
T22	noise reduced mode 2

4.2 WIND FARM NOISE VS. NOISE LIMIT CRITERIA

A scatter graph using the baseline noise data (see also Appendix A) and the derived 10 meter high wind speeds was generated and a trend line was added. It was then possible to derive the noise limit curve for each location using the trend line and noise limit criteria set out in table 4. This process was repeated for the day time and night time periods. Using the predicted L_{A90} across different wind speeds the turbine noise was plotted against the noise limit curves for N1 to N10. These curves are illustrated in Appendix B and the results presented in table 7 above.

4.3 CONSTRUCTION PHASE

The construction works will require heavy earth moving machinery involved in overburden removal, and construction of the wind farm infrastructure including roads, hard standings and substation. Table 8 below is a typical list of plant and machinery involved in a wind farm construction of this size. Traffic generated by materials delivery to site and employee traffic will also contribute to the noise level. The noise levels from the equipment identified above have been sourced from BS5228 Noise Database for Noise and Vibration Control on Construction and Open Sites-1:2009.

Table 8 Sound Power Frequency Data for Typical Construction Plant Machinery

Plant and Machinery	Octave Banding (Hz)								Sound Power Level dB(A)	Sound Pressure Level @10mdB(A)
	63	125	250	500	1k	2k	4k	8k		
Telescopic Handler	86.8	86.9	85.4	92.8	98	96.2	88	78.9	102	71
Mobile Crane	84.8	90.9	93.4	90.8	95.0	95.2	88.0	79.9	101	70
30-50T Excavator (x2)	89.8	92.9	99.4	104.8	104	103.2	100	92.9	110	79
15-30T Excavator (x4)	99.8	98.9	104.1	100.8	101	100.2	96	86.9	109	78
12T Roller (x2)	94.8	98.9	99.4	108.8	104	100.2	97	90.9	111	80
Dump truck (x5)	89.8	94.9	99.4	98.8	105	102.2	97	87.9	109	78
Tractor & Trailer (x4)	97.8	100.9	98.4	103.8	104	104.2	96	88.9	110	79
15-20T Rubber Tired Excavator	78.8	80.9	86.4	91.8	94	92.2	91	79.9	99	68
Erection and Assist Crane (x2)	70.8	85.9	90.4	89.8	97	98.2	87	75.9	102	71
3-10T mini digger	85.8	86.9	90.4	90	95.0	90	92	84.9	100	69
Rock Breaker	83.8	96.9	103.4	109.8	117	118.2	118	114.9	123	92
Diesel Generator	84.8	88.9	79.4	81.8	84	80.2	77	66.9	92	61

The estimated programme of works for construction indicates a 6 to 8 month period. The construction works will be phased and all the noise sources presented in table 8 will not be in operation continuously or simultaneously for the duration of the construction phase. However for the purpose of this assessment a worst case scenario has been assumed and all the items of machinery have been modelled as if they were in operation continuously and simultaneously over the course of a twelve hour working day.

The results of the construction noise predictive modelling indicate that the appropriate threshold of significance **(65dB (A))** as outlined in BS5228-1:2009 will not be exceeded beyond 200m. There are no dwellings within this range. The results are illustrated in table 9 below. In reality all items of plant will not be operating at the same location and at the same time, therefore it is reasonable to conclude that the noise levels experienced by the receiving environment will be much lower.

Table 9 Theoretical Worst Case Scenario Construction Noise

Distance to receiver (m)	Theoretical Worst Case Scenario dB(A)
100	72
200	64
300	60
400	57
500	54

4.4 VIBRATION, LOW FREQUENCY NOISE AND HEALTH

4.4.1 Vibration

Although there is no Irish guidance on vibration, low frequency noise and health, it is an issues that crops up regularly. A study of low frequency noise and vibration around a modern wind farm was carried out for ETSU and reported in ETSU W/13/00392/REP, Low Frequency Noise and Vibrations Measurement at a Modern Wind Farm. The study found that vibration levels 100m from the nearest turbine were a factor of 10 less than those recommended for human exposure in sensitive buildings, such as hospitals or laboratories housing precision measurement instruments.

These findings were confirmed in July 2005 by the Applied and Environmental Geophysics Group of the School of Physical and Geographical Sciences at Keele University. Keele University undertook an assessment of the likely impact of ground borne vibrations from wind turbines on the seismic array at Eskdalemuir, Scotland. Eskdalemuir, in the Scottish Borders, is in the location of a monitoring facility operated by the British Geological Survey where seismological, magnetic and other environmental parameters are monitored because the site is located in a very quiet and seismic environment. Testing showed that vibration can be detected several kilometres from the wind turbines. However, Keele University clarified the context of their results.

"The level of vibration from wind turbines is so small that only the most sophisticated instrumentation and data processing can reveal their presence, and they are almost impossible to detect. The Dun Law study was designed to measure effects of extremely low level vibration on one of the quietest sites in the world (Eskdalemuir) and

one which houses one of the most sensitive seismic installations in the world. Vibrations at this level and in this frequency range will be available from all kinds of sources such as traffic and background."

In a recent letter to the press two of the authors of this report stated that '*to put the level of vibration into context, they are ground vibrations with amplitudes of about one millionth of a millimetre. There is no possibility of humans sensing the vibration and absolutely no risk to human health'.*

4.4.2 Infrasound and Low Frequency Noise

Infrasound is the term generally used to describe sound below that at which is normally audible, at frequencies below 20Hz. At separation distances from wind turbines which are typical of residential locations, the levels of infrasound from wind turbines are well below the human perception level. Infrasound from wind turbines is often at levels below that of the noise generated by wind around buildings and other obstacles. Sounds at frequencies from about 20Hz to 200Hz are conventionally referred to as low frequency sounds. A report for the Department of Trade and Industry (DTI) in 2006 by Hayes McKenzie concluded that neither infrasound nor low frequency noise was a significant factor at the separation distances at which people lived.

4.4.3 Wind Farms Noise and Health

To date there is no published evidence to suggest a direct link between wind farms and health. The main publications supporting these views include.

a) Australian National Health and Medical Research Council (NHMRC) July 2010

"There is currently no published scientific evidence to positively link wind turbines with adverse health effects".

b) Wind Turbine Sound and Health Effects - An Expert Panel Review - American Wind Energy Association and Canadian Wind Energy Association December 2009

"There is no evidence that the audible or sub-audible sounds emitted by wind turbines have any direct adverse physiological effects.
The ground-borne vibrations from wind turbines are too weak to be detected by, or to affect, humans.
The sounds emitted by wind turbines are not unique. There is no reason to believe, based on the levels and frequencies of the sounds and the panel's experience with sound exposures in occupational settings, that the sounds from wind turbines could plausibly have direct adverse health consequences."

c) Renewable UK - Wind Turbine Syndrome - An independent review of the state of knowledge about the alleged health condition July 2010

"There is no reason to believe that the sounds from wind turbines could plausibly have direct adverse health consequence"

4.5 MITIGATION MEASURES

4.5.1 Operational Phase

This assessment has been based on a typical turbine suitable for the site, operating in normal mode. Four locations have been identified where the noise limit could be exceeded by 1 or 2 dB(A). However these locations are either empty or have a financial involvement. The owners may consent to the increase over the limit or the selected turbine will be programmed to the most appropriate noise reduced mode to ensure compliance with the noise limit (see also table 6 and table 7).

4.5.2 Construction Phase

Best practice in the form of *BS5228 –1&2:2009, Code of Practice for the Control of Noise and Vibration on Construction and Open Sites* should be adopted during the construction phase in order to minimise the noise generated by construction activities and nuisance to neighbours.

4.6 RESIDUAL IMPACTS

While noise from wind turbines may be audible at certain locations under certain meteorological conditions, noise levels will predicted to exceed the DoEHLG Wind Energy Planning Assessment Criteria designed for the protection of residential amenity at the majority of locations, once mitigation measures are employed.

4.7 CONCLUSION

An assessment of the likely noise impact of the proposed Upperchurch Wind Farm has been carried out.

Typical downwind turbine noise levels at the closest residential locations to the site have been predicted based on provided sound power level data for a Vestas V90 wind turbine.

The assessment has been carried out in accordance with methodology described in ETSU-R-97, Assessment and Rating of Noise from Wind Farms.

The results show that the predicted wind farm noise levels adhere to the assessment criteria and in particular the DoEHLG Wind Farm Planning Guidelines.

Figure 1 Wind Farm and all dwellings within 900m

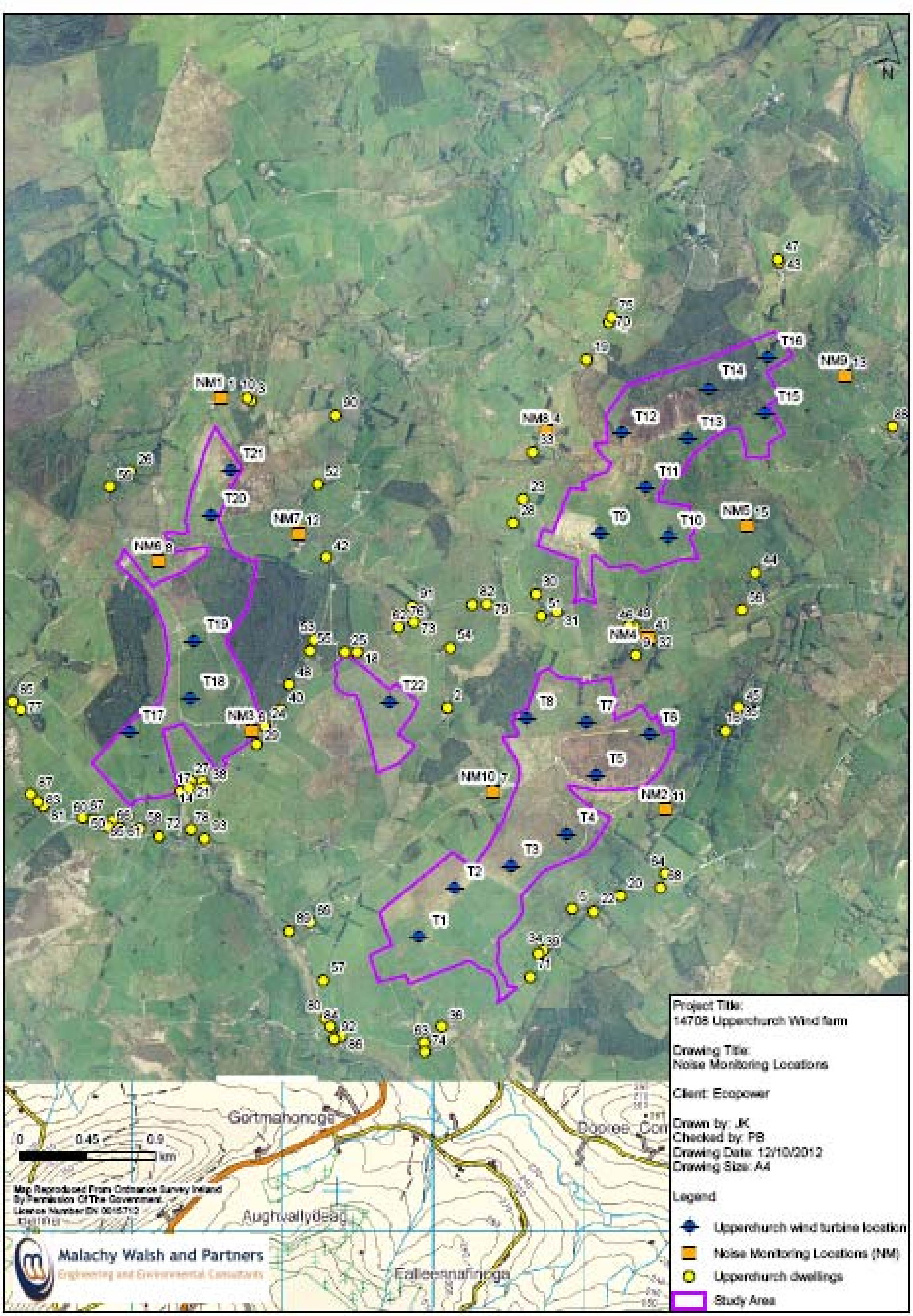
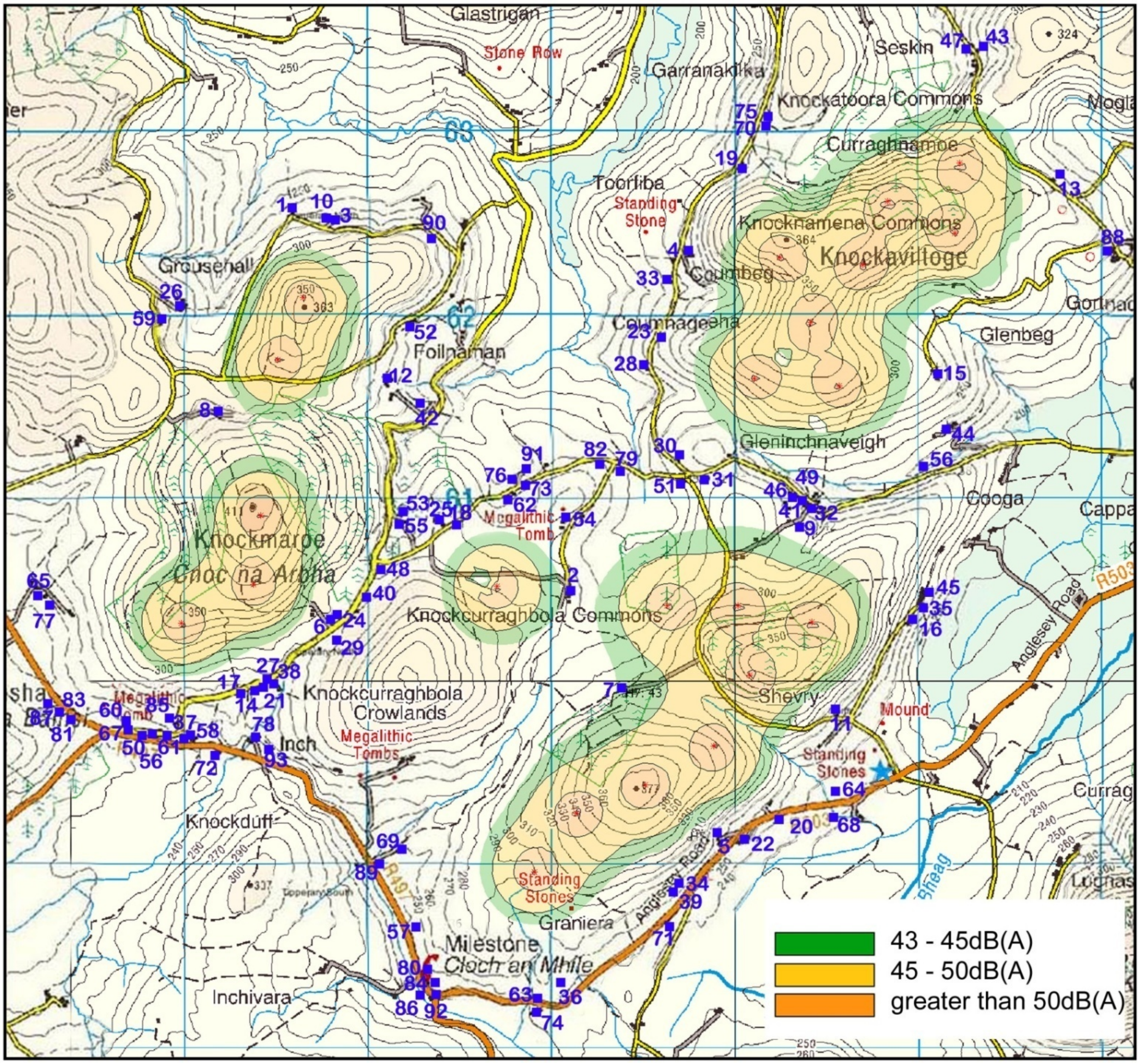


Figure 2 Predicted Noise Level at 8m/s (unmitigated, all areas outside shading are below L90 43dB(A)



4.8 REFERENCES

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JOULE project JOR3-CT95-0051 '*Development of a wind farm Noise Prediction Model'.*

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Renewable UK - *Wind Turbine Syndrome - An Independent review of the State of Knowledge about the Alleged Health Condition July 2010*

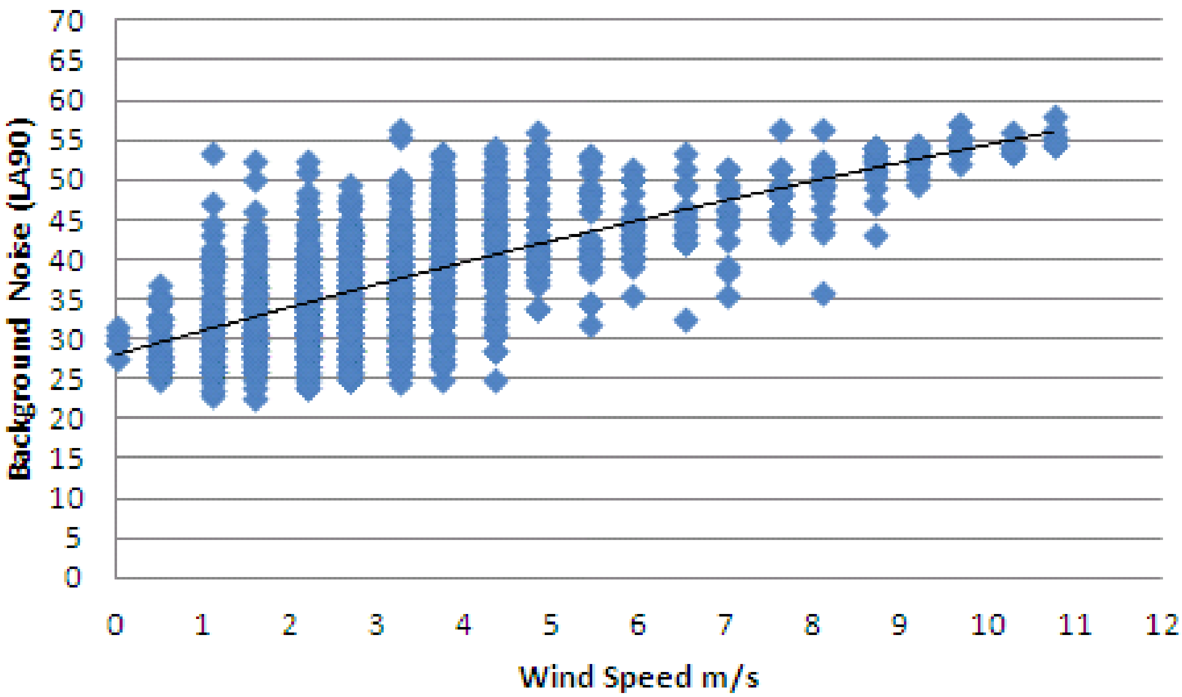
Wind Turbine Sound and Health Effects - An Expert Panel Review - American Wind Energy Association and Canadian Wind Energy Association December 2009

W/45/00656/00/00 .*The Measurement of Low Frequency Noise at Three UK Windfarms.* Department of Trade and Industry, 2006.

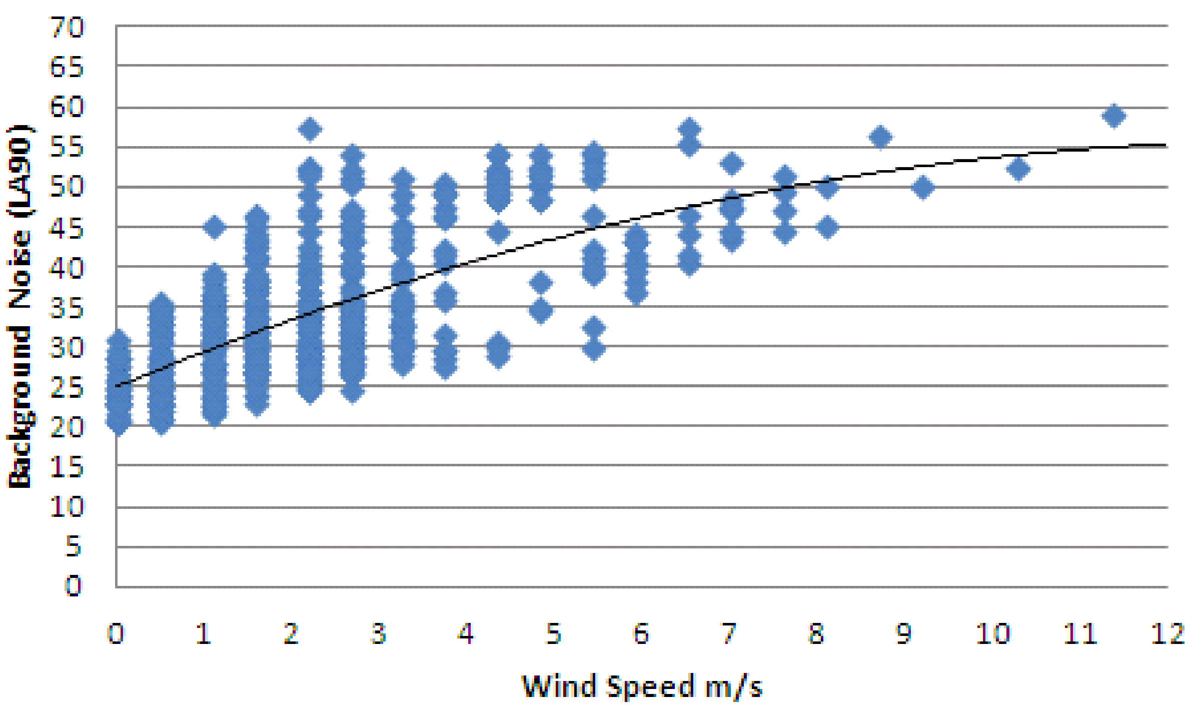
Appendix A

Prevailing Background Noise Levels at NM1 to NM10

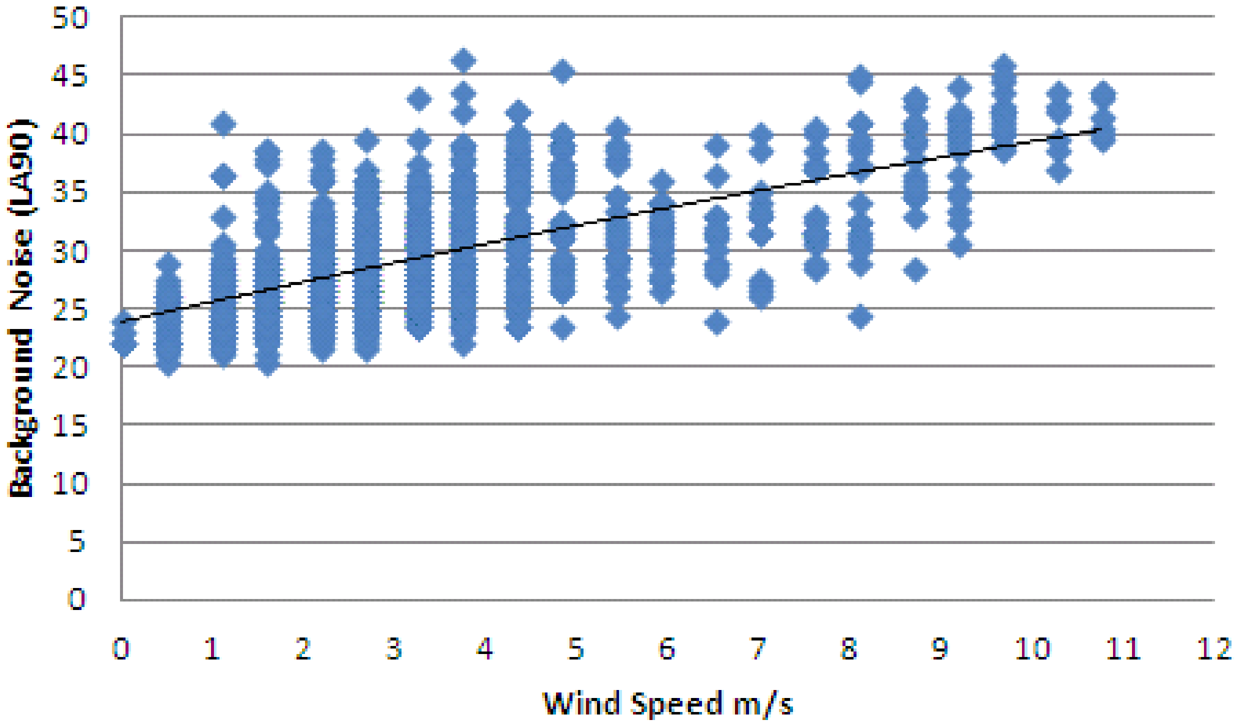
Location N1 Daytime Prevailing Background Noise Level



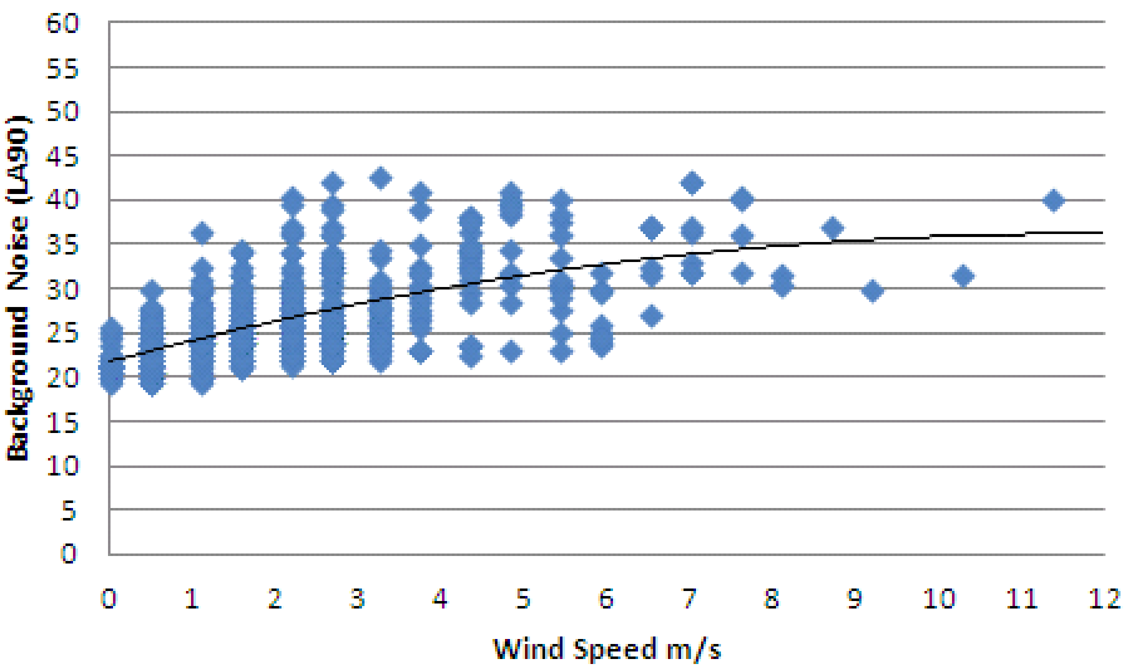
Location N1 Night time Prevailing Background Noise Level



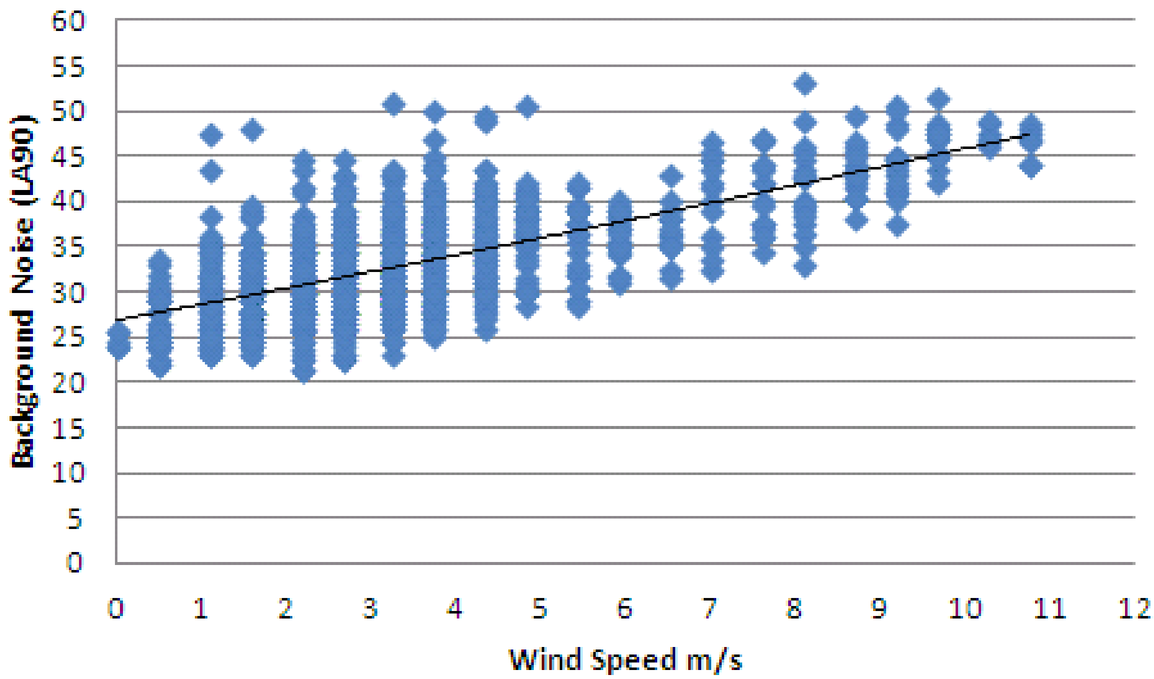
Location N2 Day time Prevailing Background Noise Level



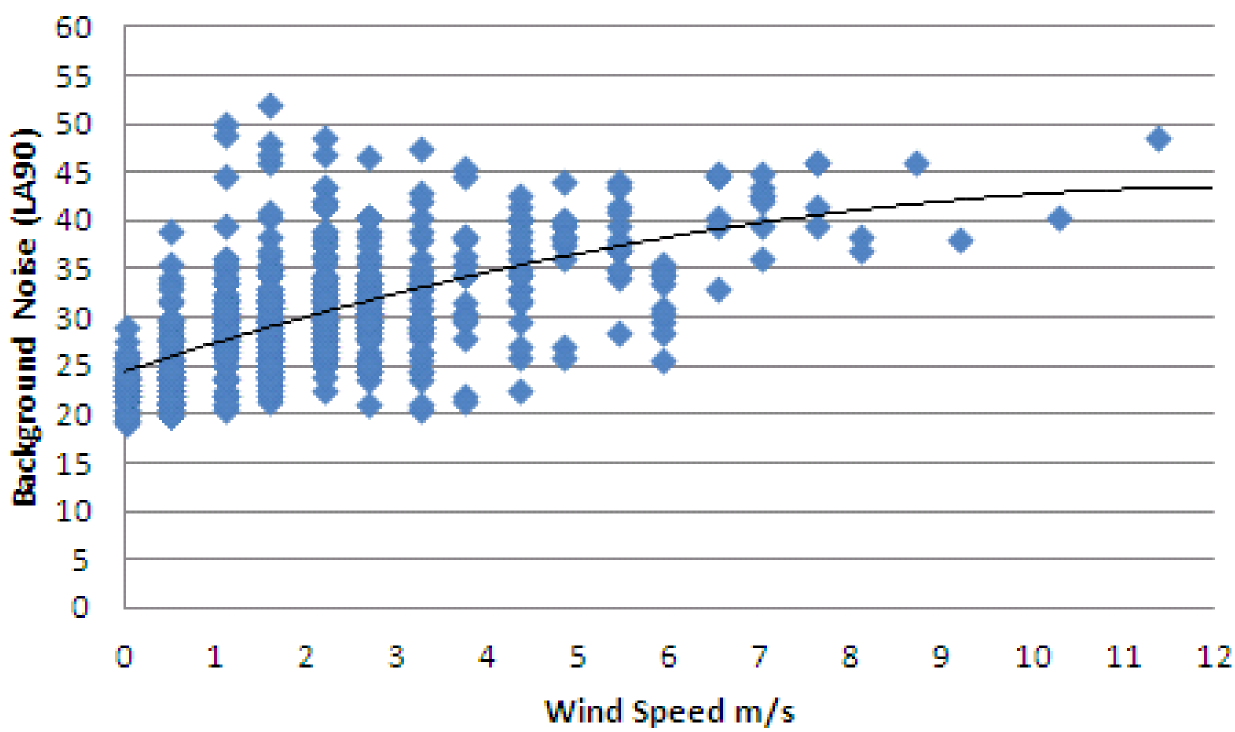
Location N2 Night time Prevailing Background Noise Level



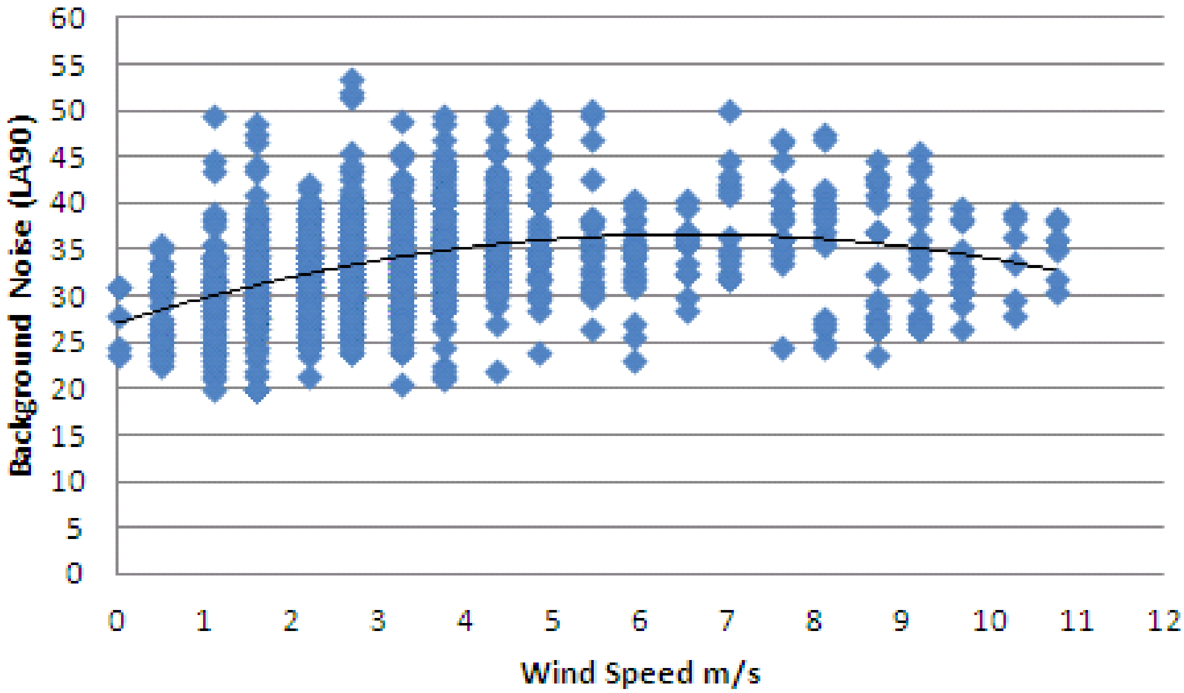
Location N3 Day time Prevailing Background Noise Level



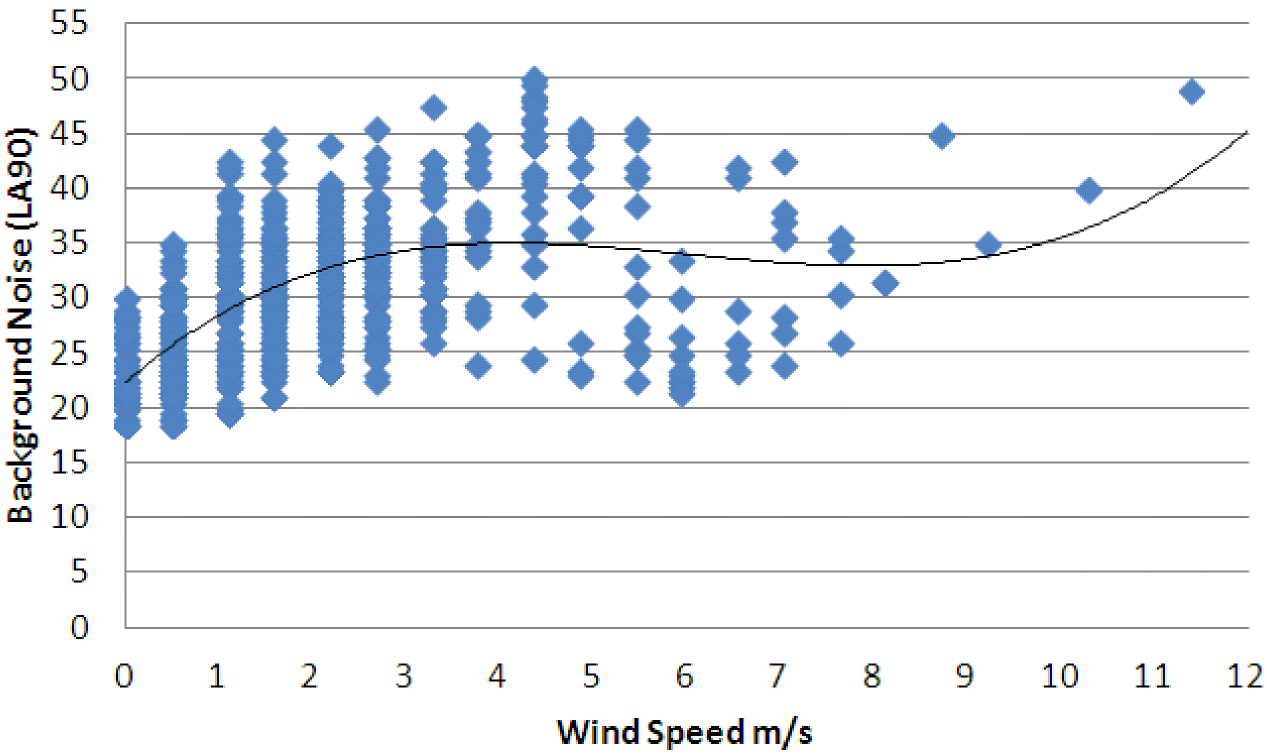
Location N3 Night time Prevailing Background Noise Level



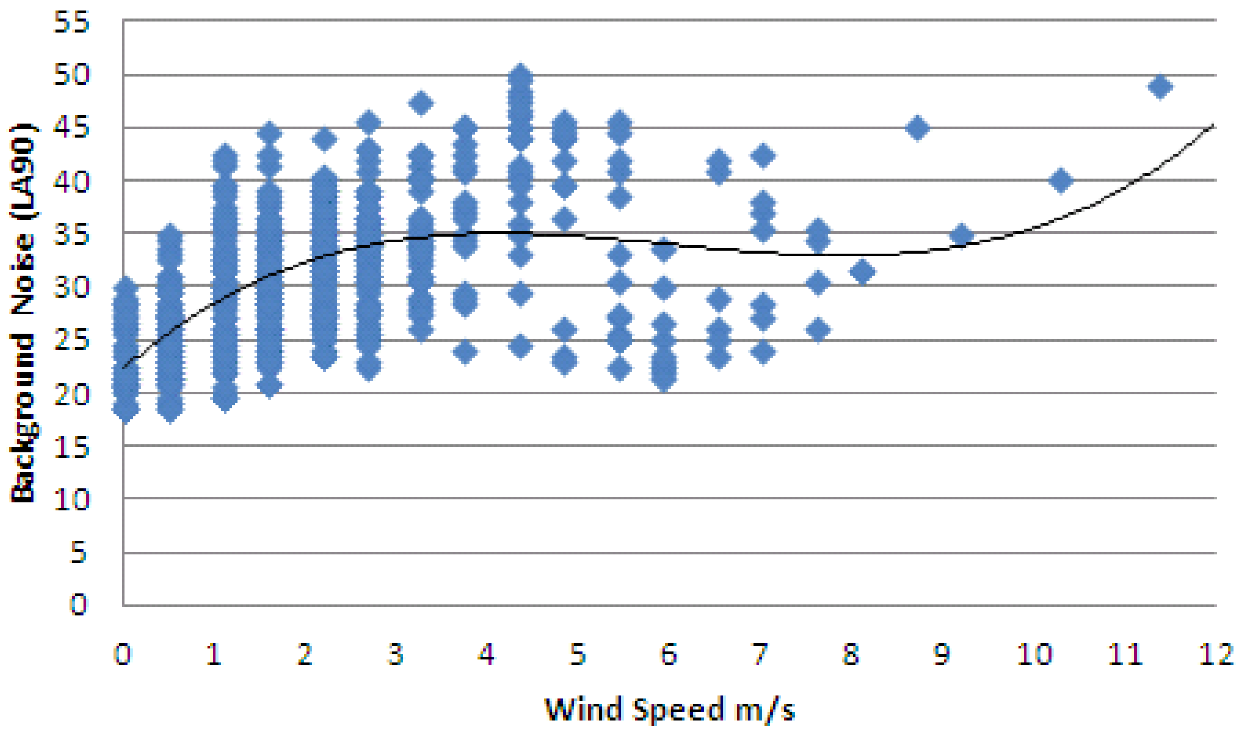
Location N4 Day time Prevailing Background Noise Level



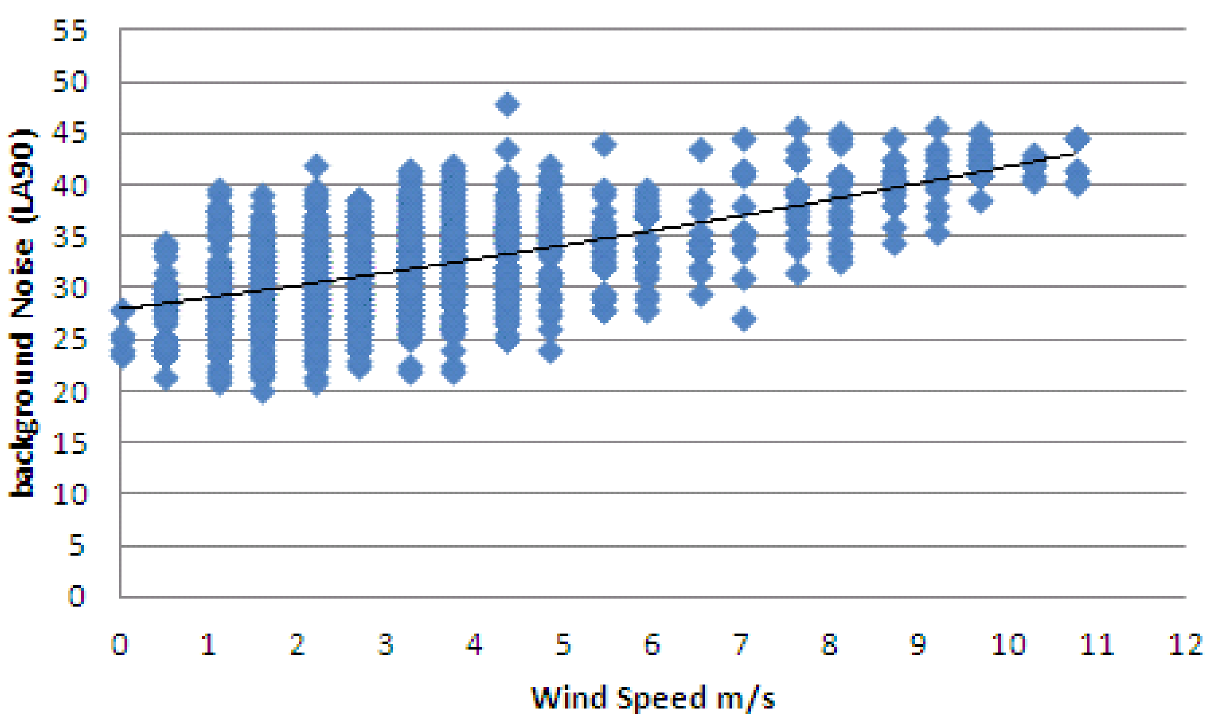
Location N4 Night time Prevailing Background Noise Level



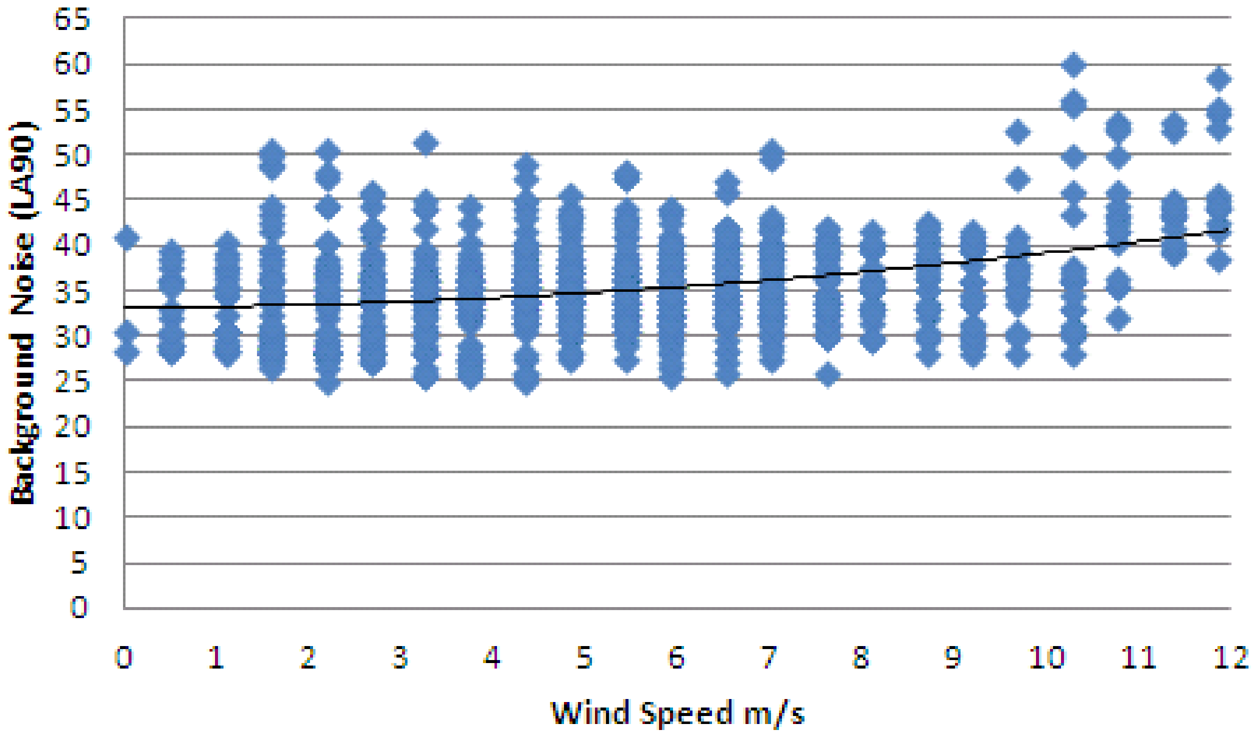
Location N5 Day time Prevailing Background Noise Level



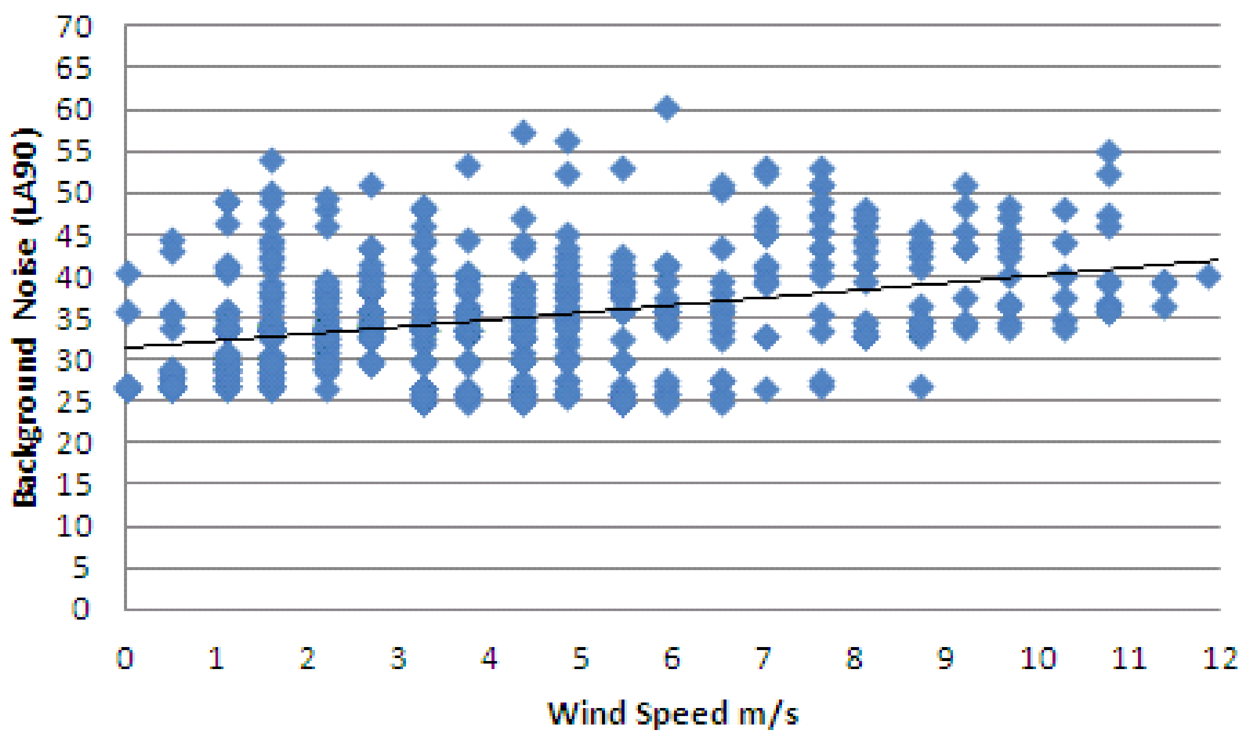
Location N5 Night time Prevailing Background Noise Level



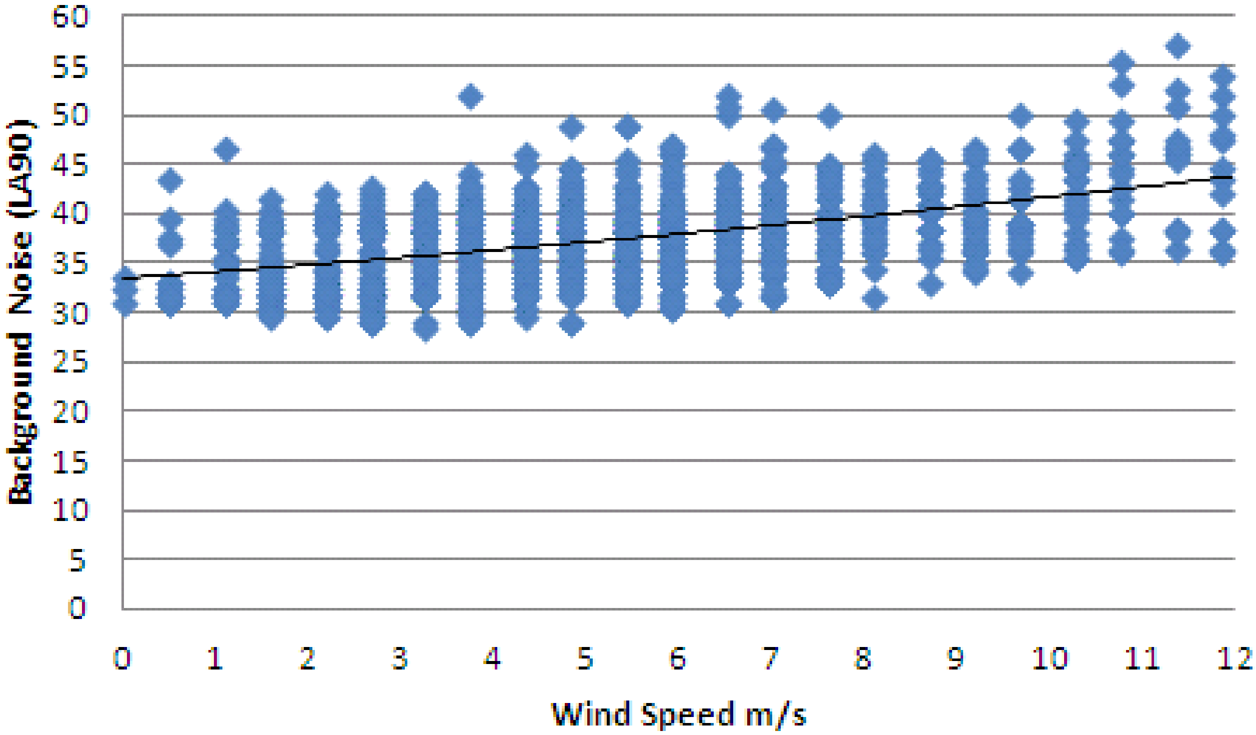
Location N6 Day time Prevailing Background Noise Level



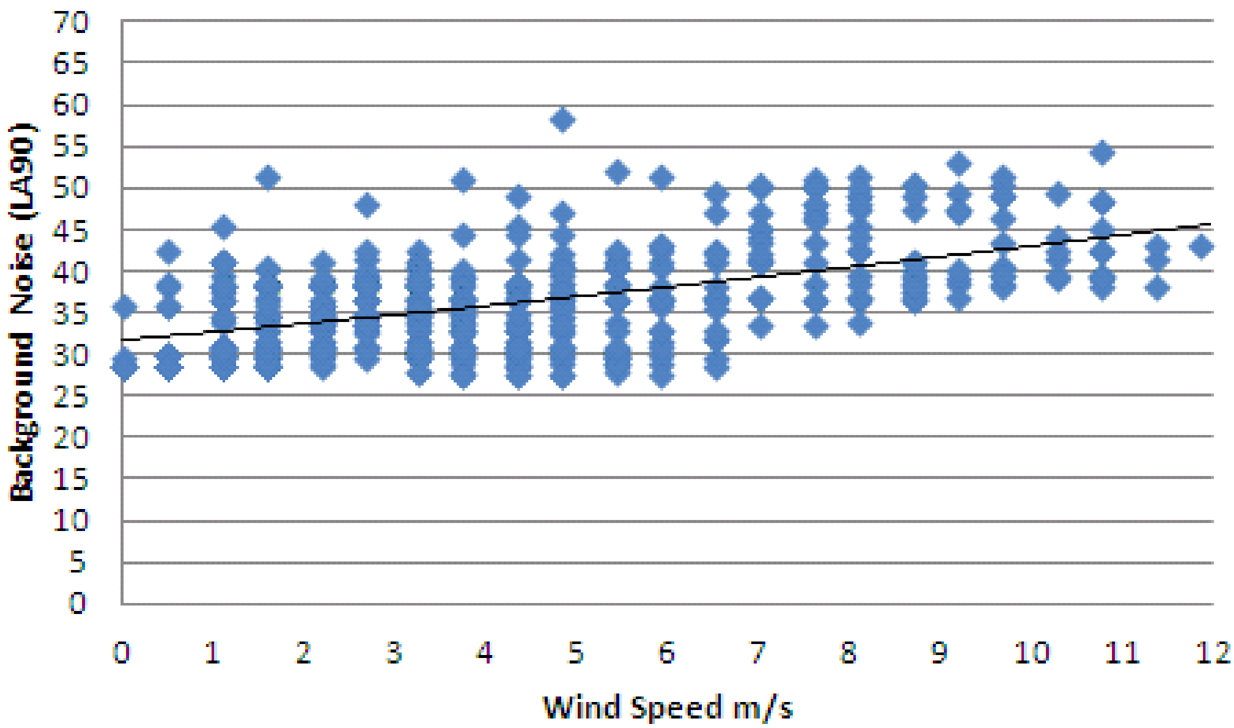
Location N6 Night time Prevailing Background Noise Level



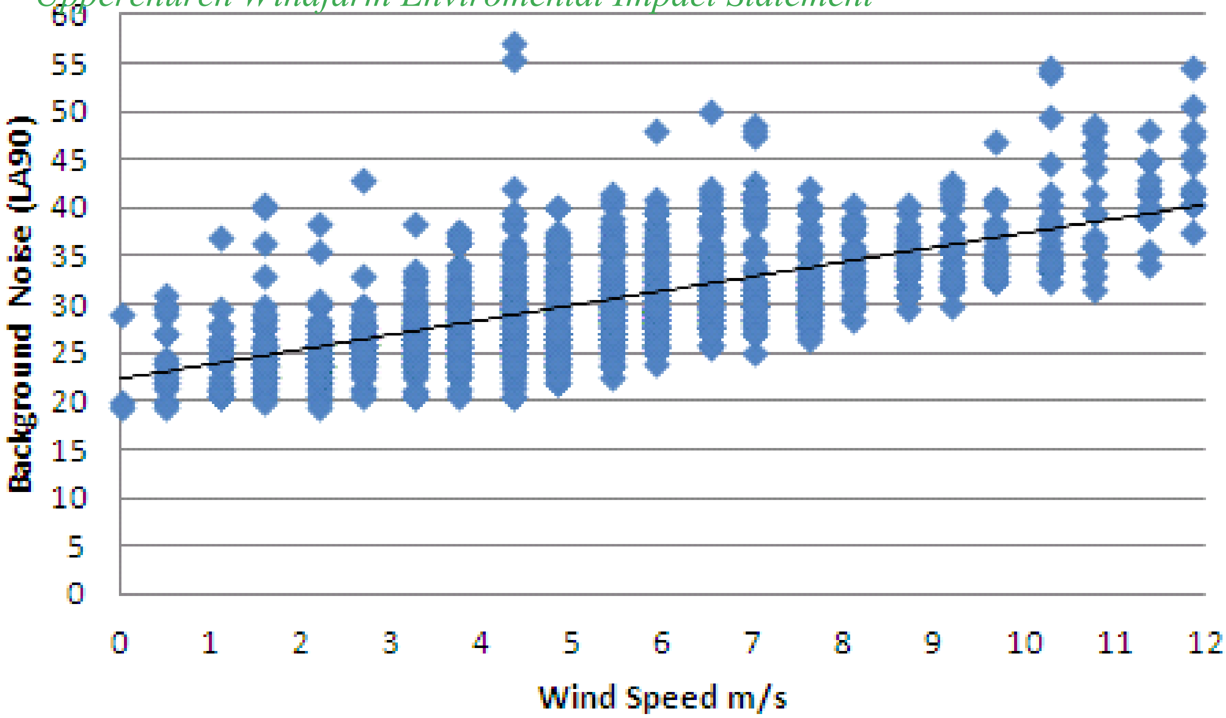
Location N7 Day time Prevailing Background Noise Level



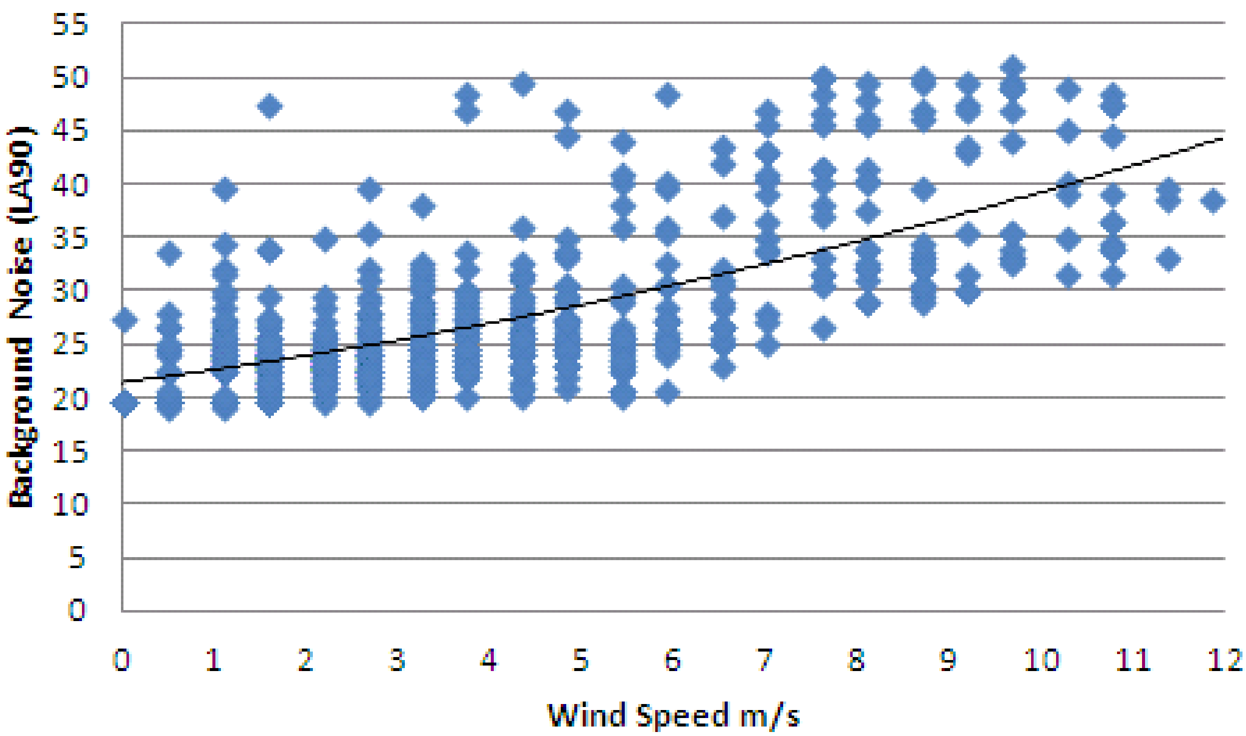
Location N7 Night time Prevailing Background Noise Level



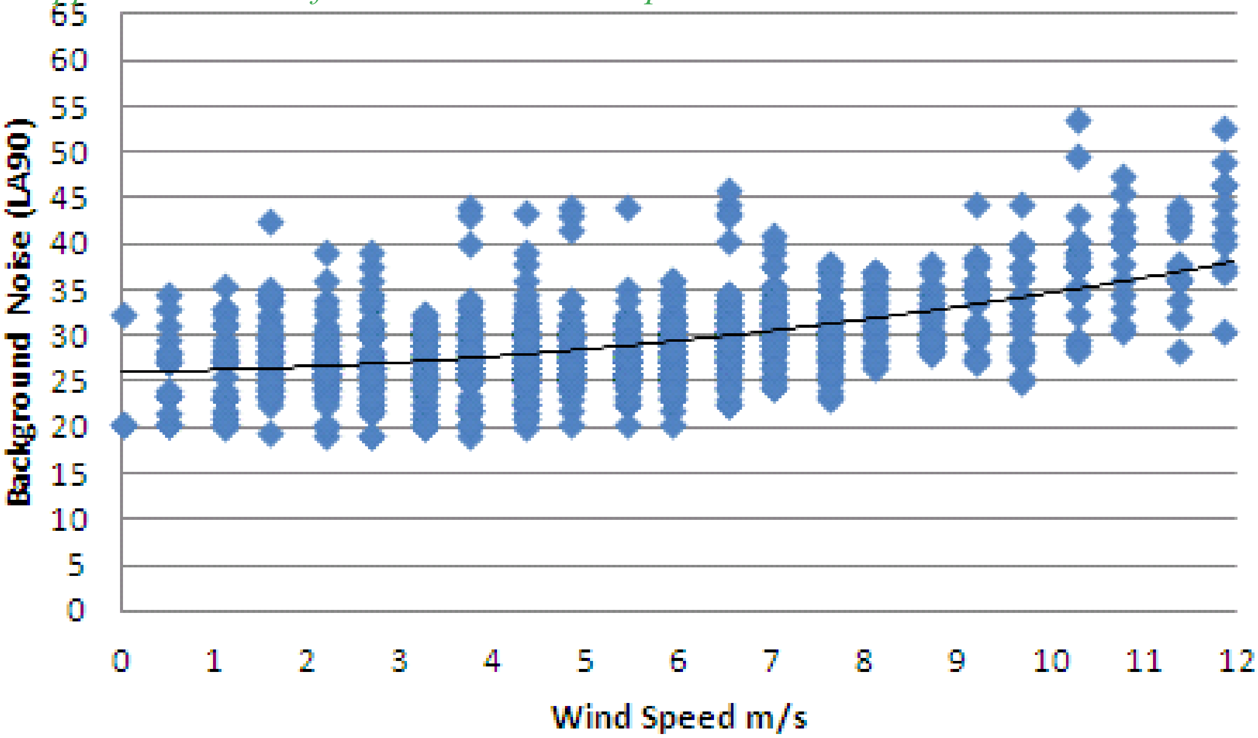
Location N8 Day time Prevailing Background Noise Level



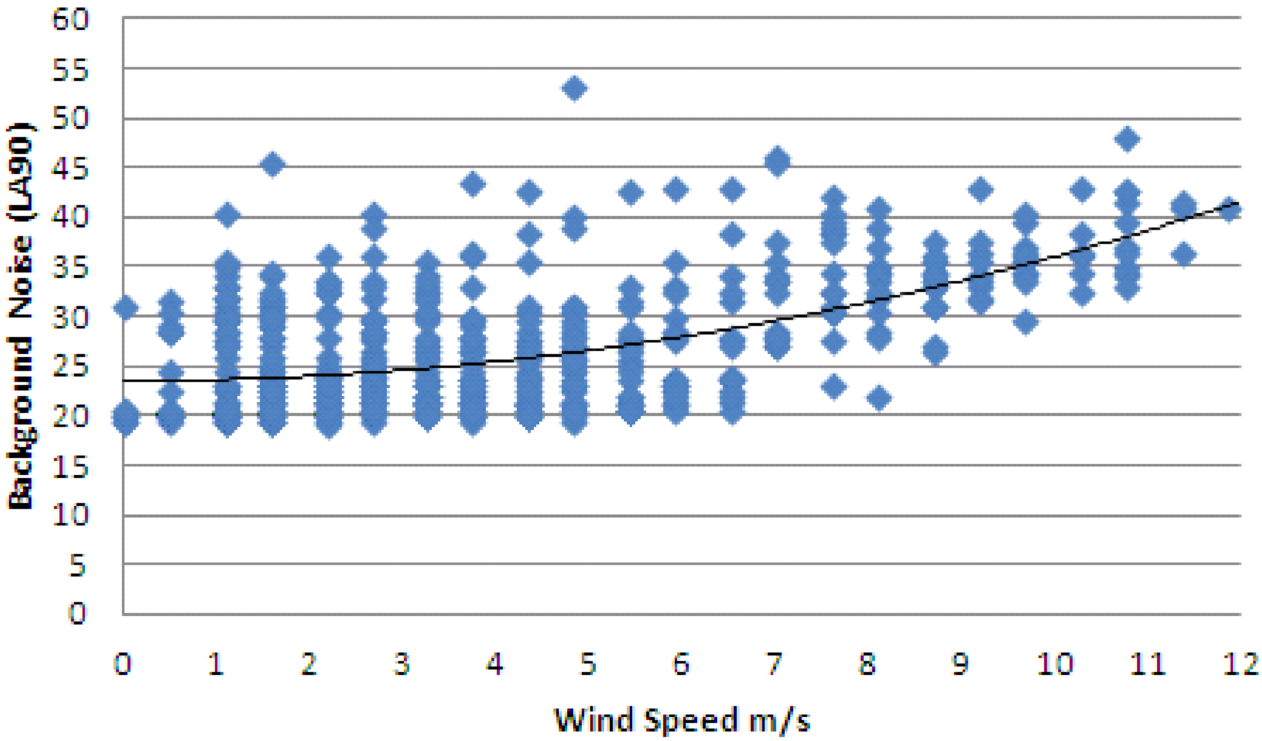
Location N8 **Night time Prevailing Background Noise Level**



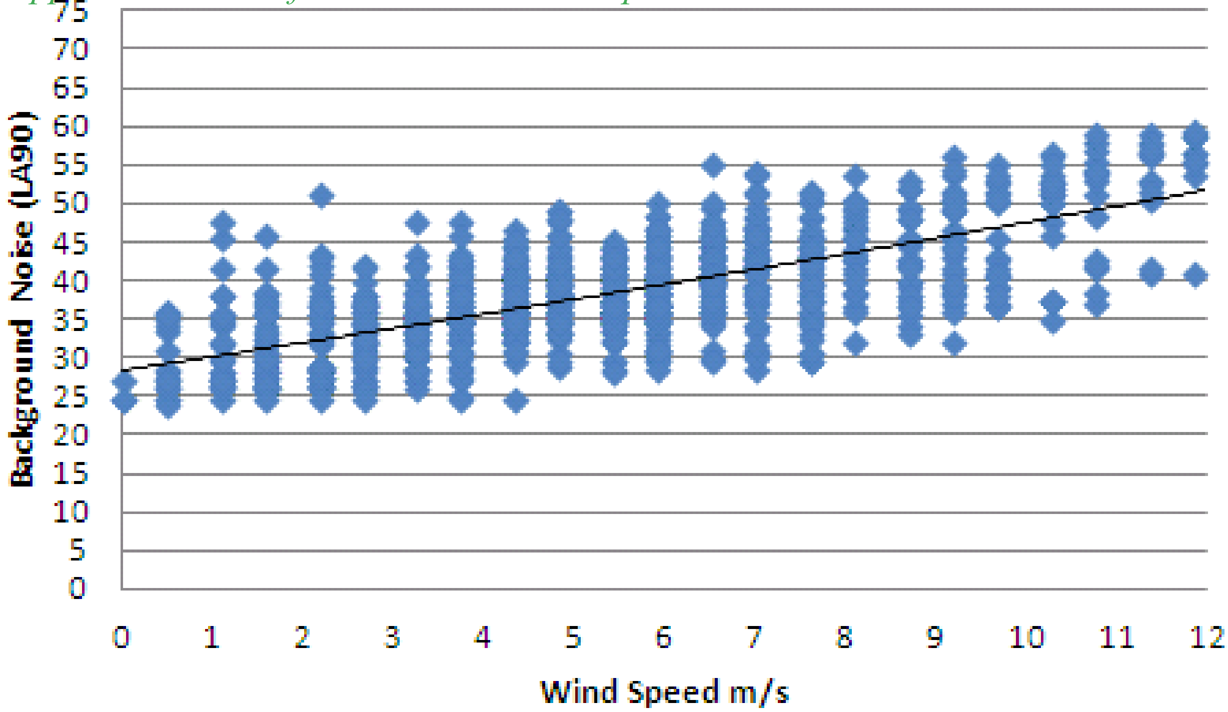
Location N9 **Day time Prevailing Background Noise Level**



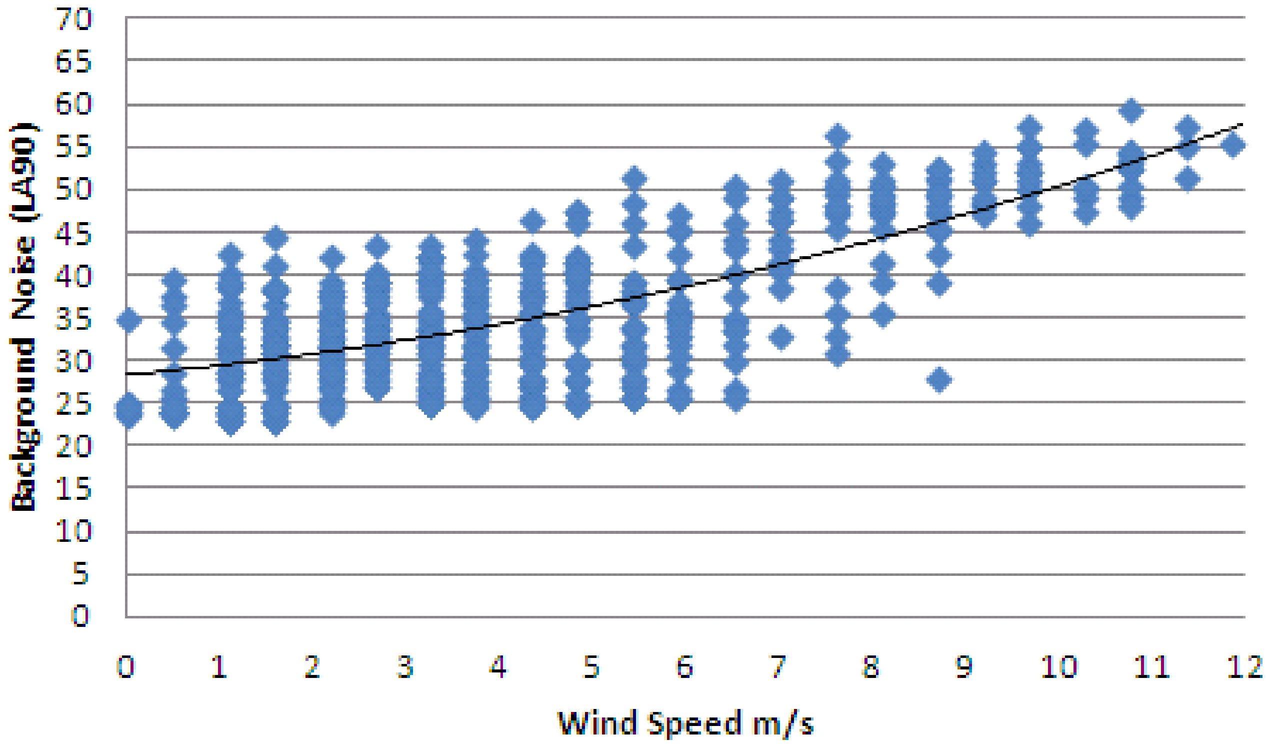
Location N9 **Night time Prevailing Background Noise Level**



Location N10 **Day time Prevailing Background Noise Level**



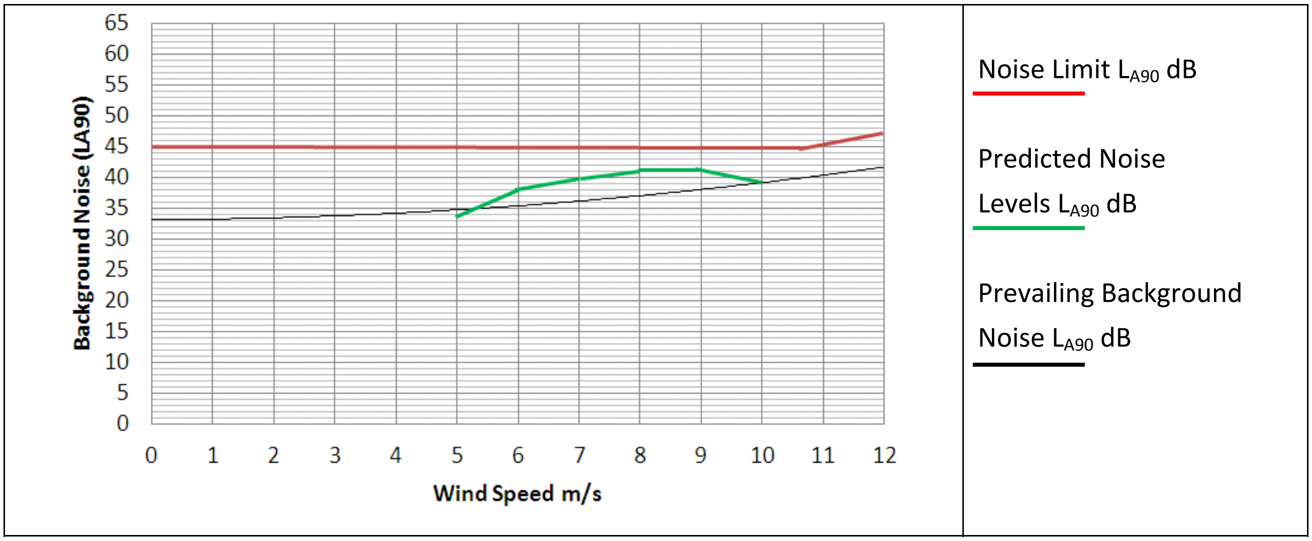
Location N10 Night time Prevailing Background Noise Level



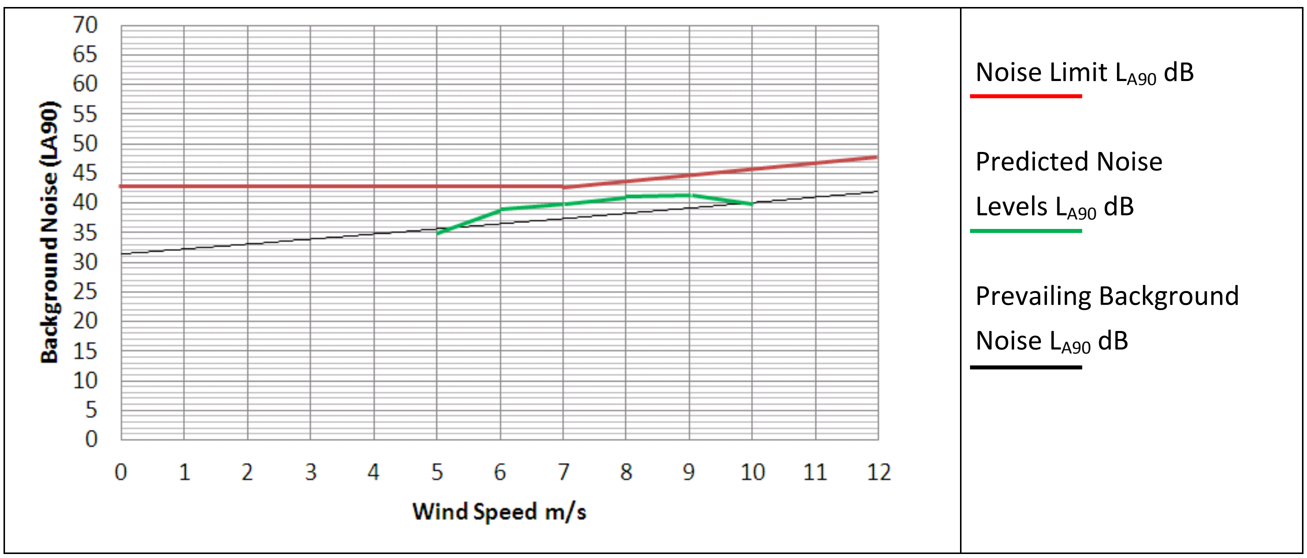
Appendix B

Noise Limit Curves

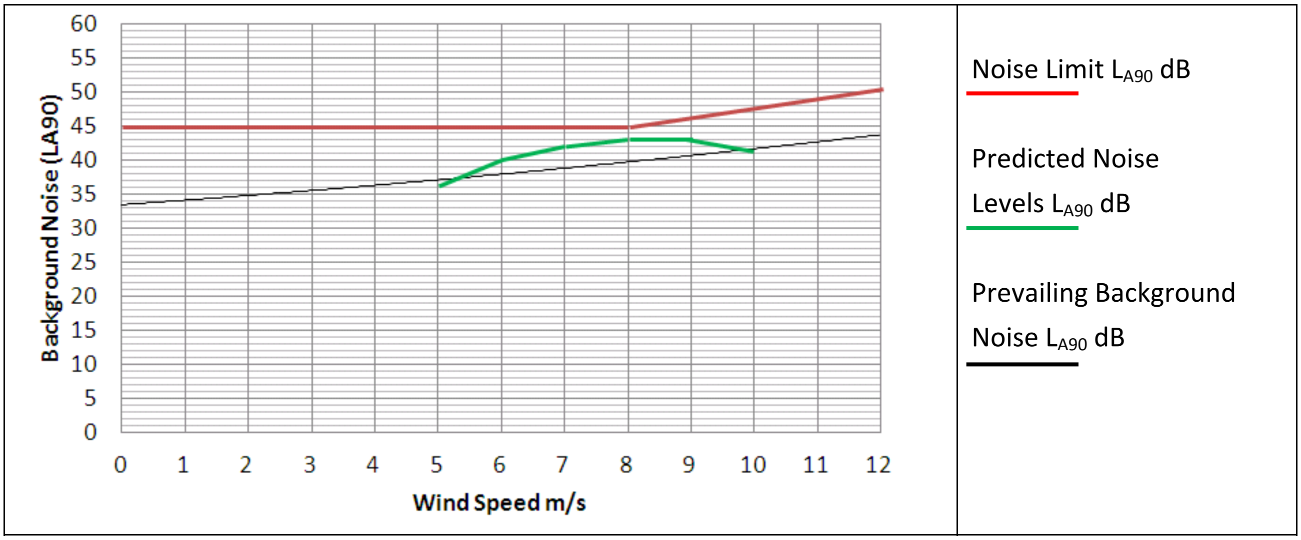
Location N1 Daytime Noise Limit Curve



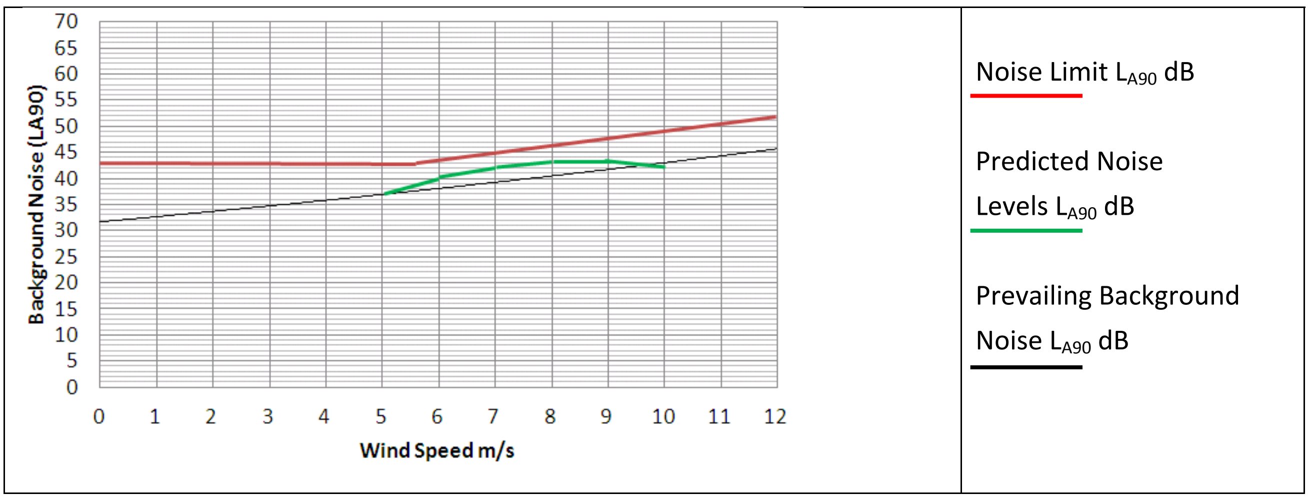
Location N1 Night time Noise Limit Curve



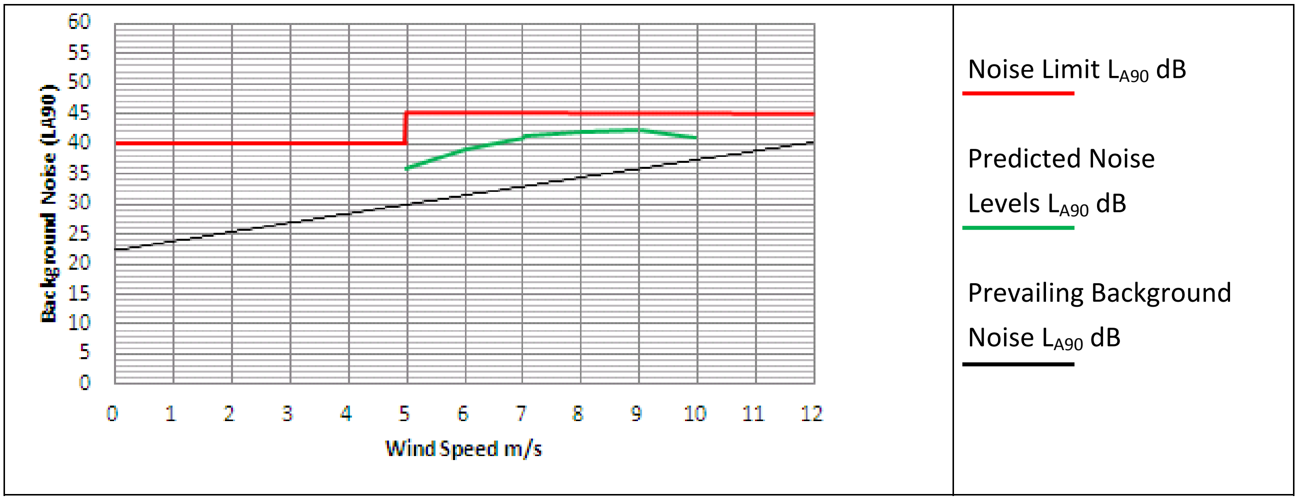
Location N2 Day time Noise Limit Curve



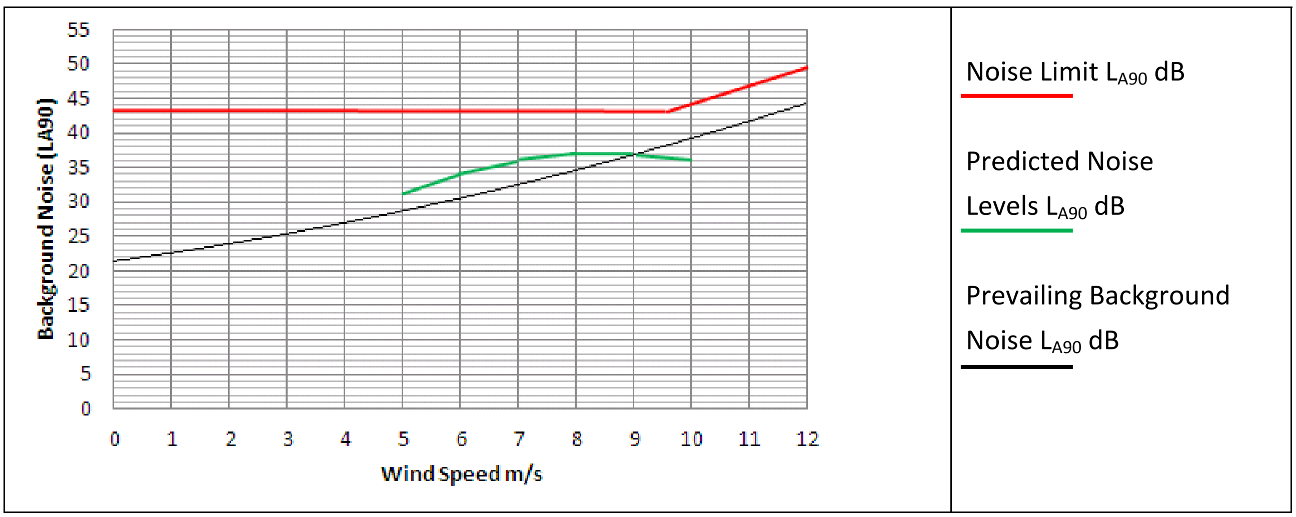
Location N2 Night time Noise Limit Curve



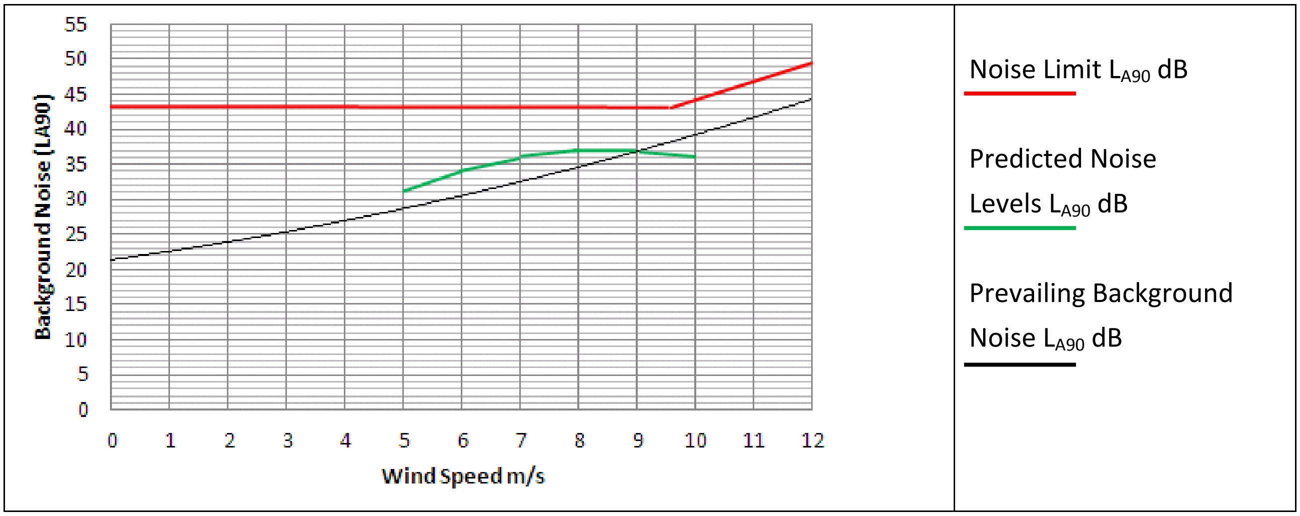
Location N3 Day time Noise Limit Curve



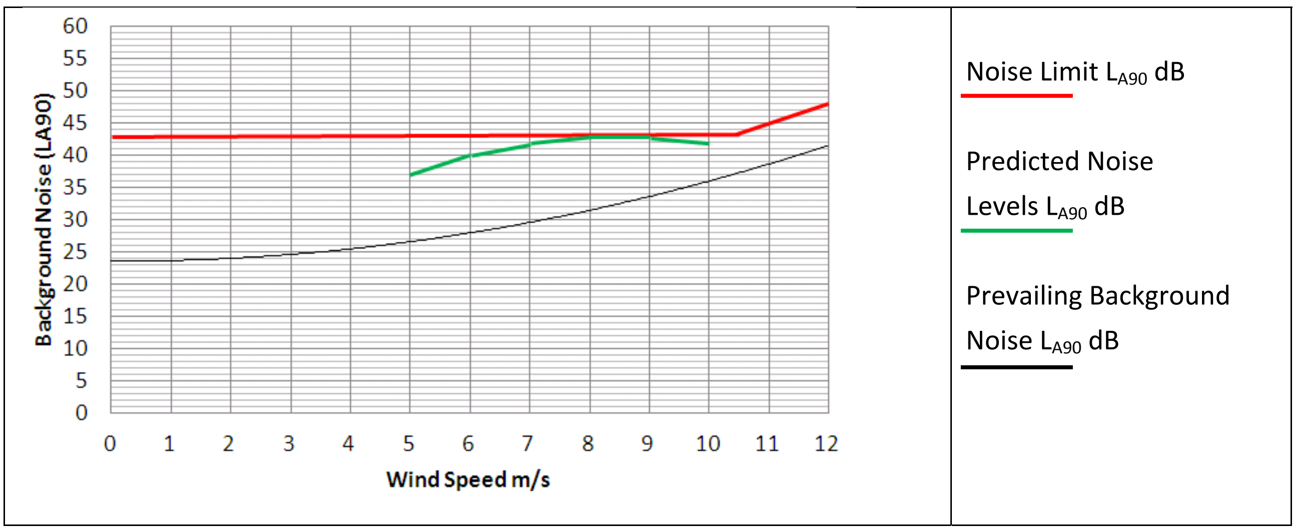
Location N3 Night time Noise Limit Curve



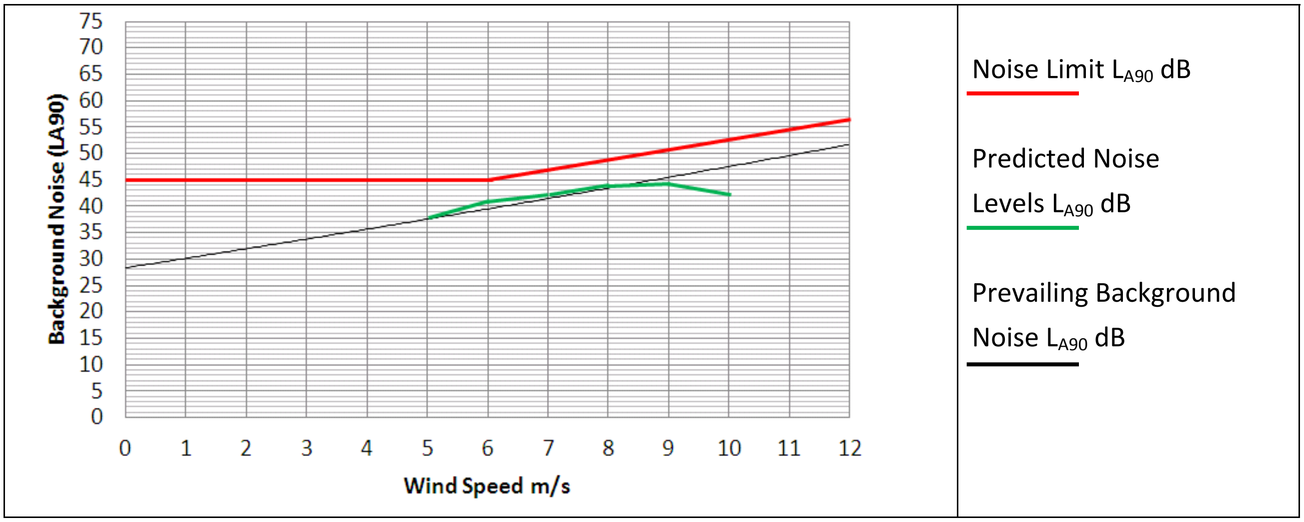
Location N4 Day time Noise Limit Curve



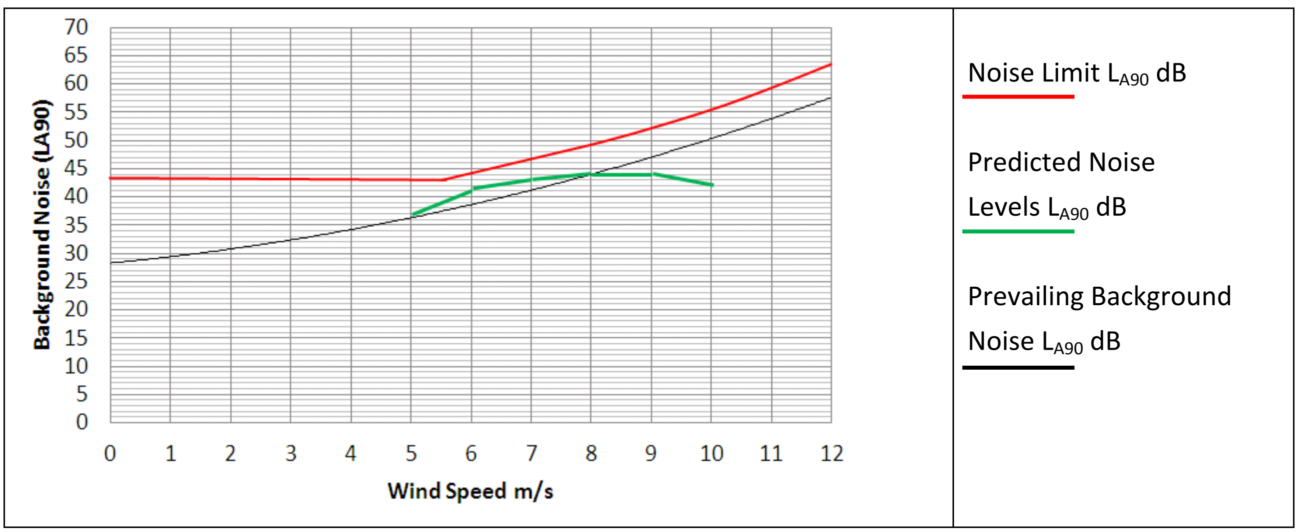
Location N4 Night time Noise Limit Curve



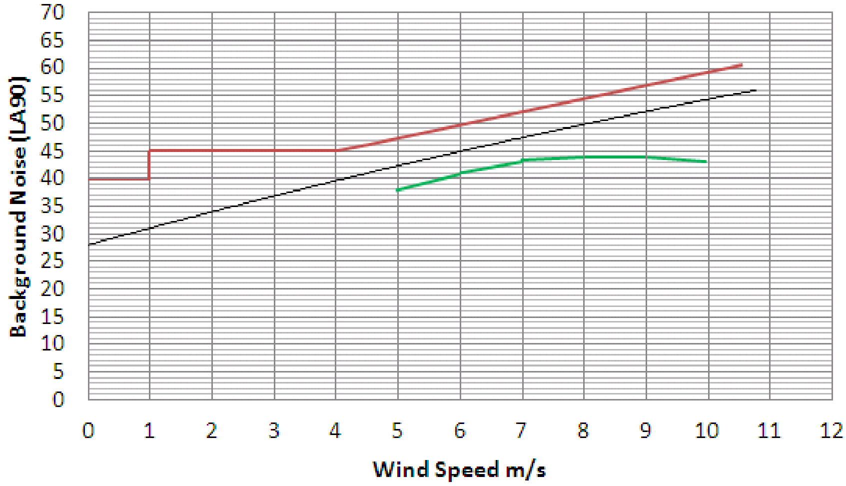
Location N5 Day time Noise Limit Curve



Location N5 Night time Noise Limit Curve



Location N6 Day time Noise Limit Curve

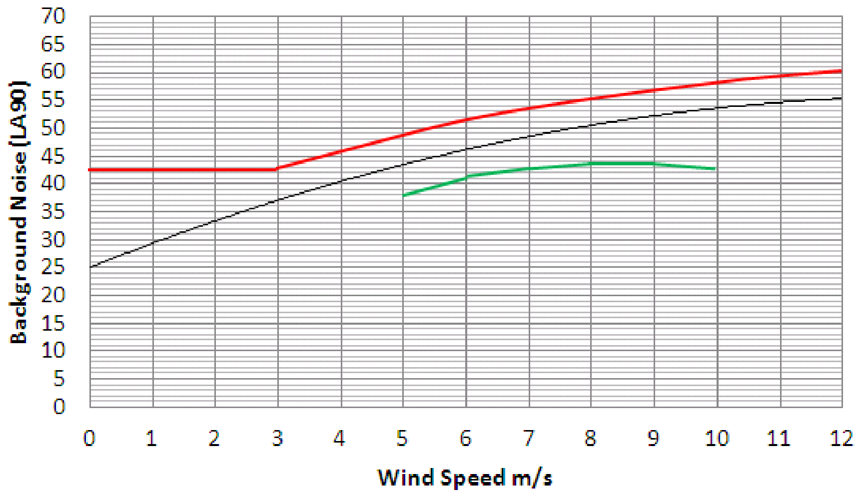


Noise Limit L_{A90} dB

Predicted Noise Levels L_{A90} dB

Prevailing Background Noise L_{A90} dB

Location N6 Night time Noise Limit Curve

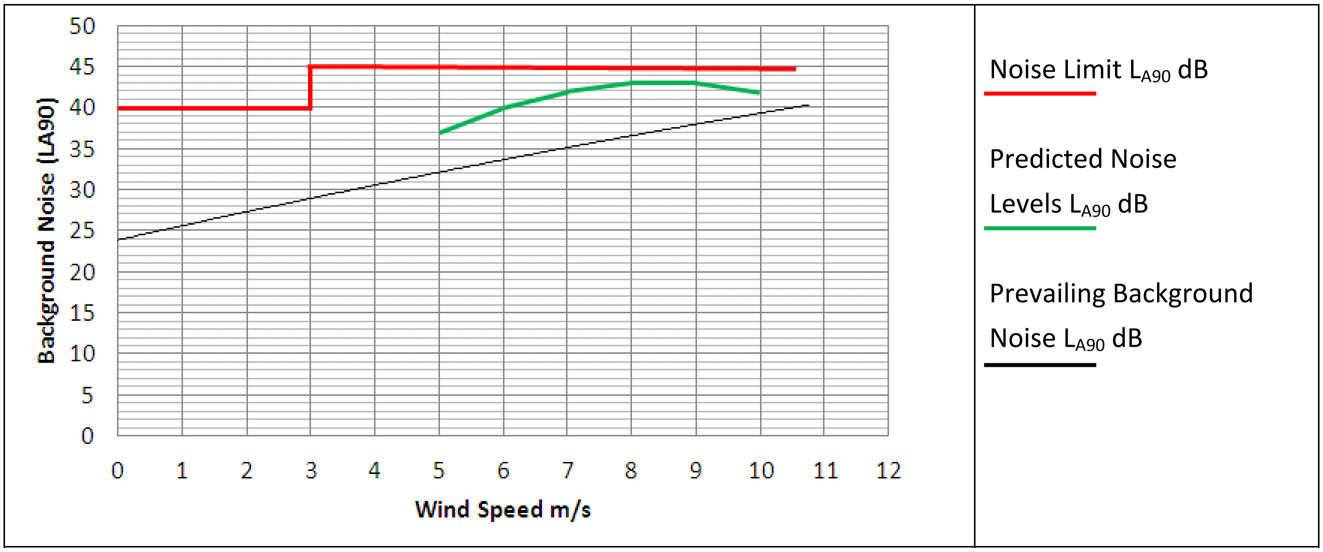


Noise Limit L_{A90} dB

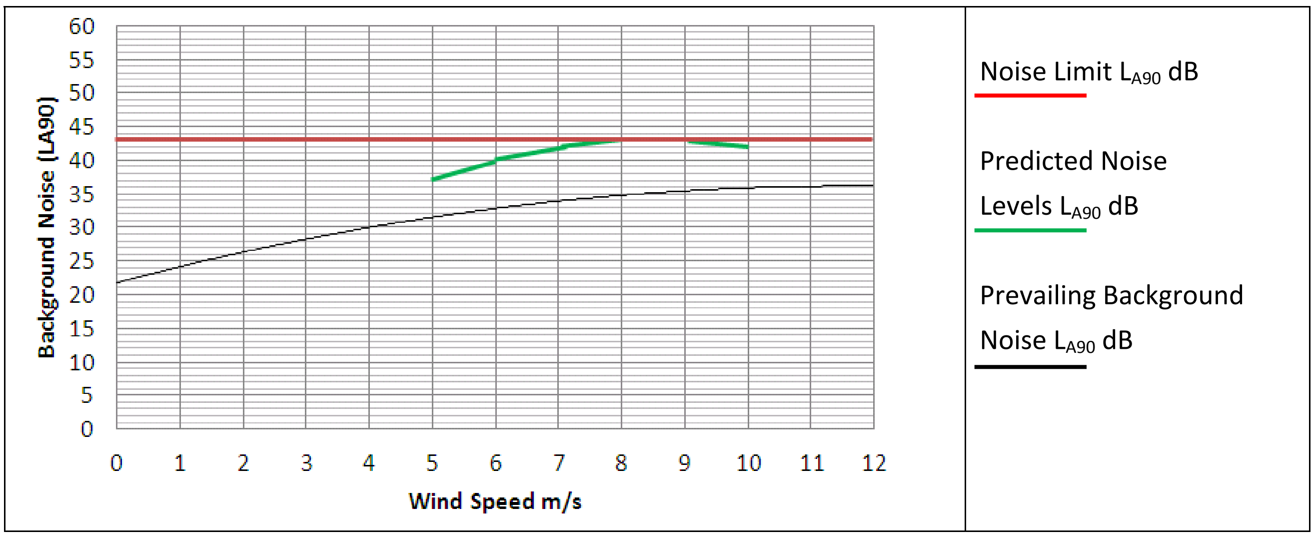
Predicted Noise Levels L_{A90} dB

Prevailing Background Noise L_{A90} dB

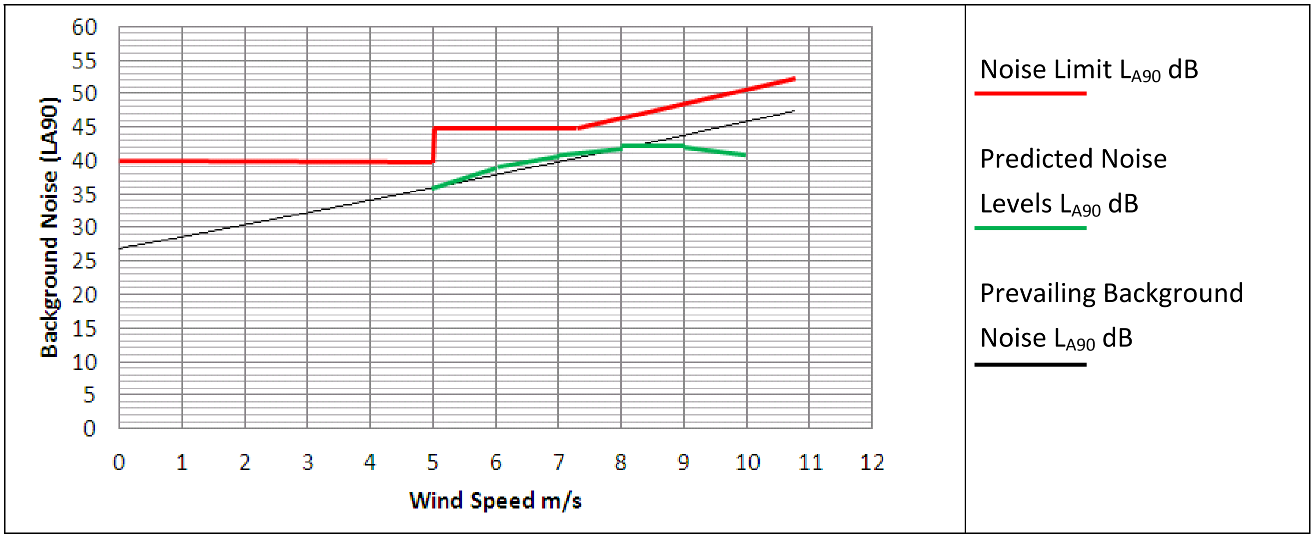
Location N7 Day time Noise Limit Curve



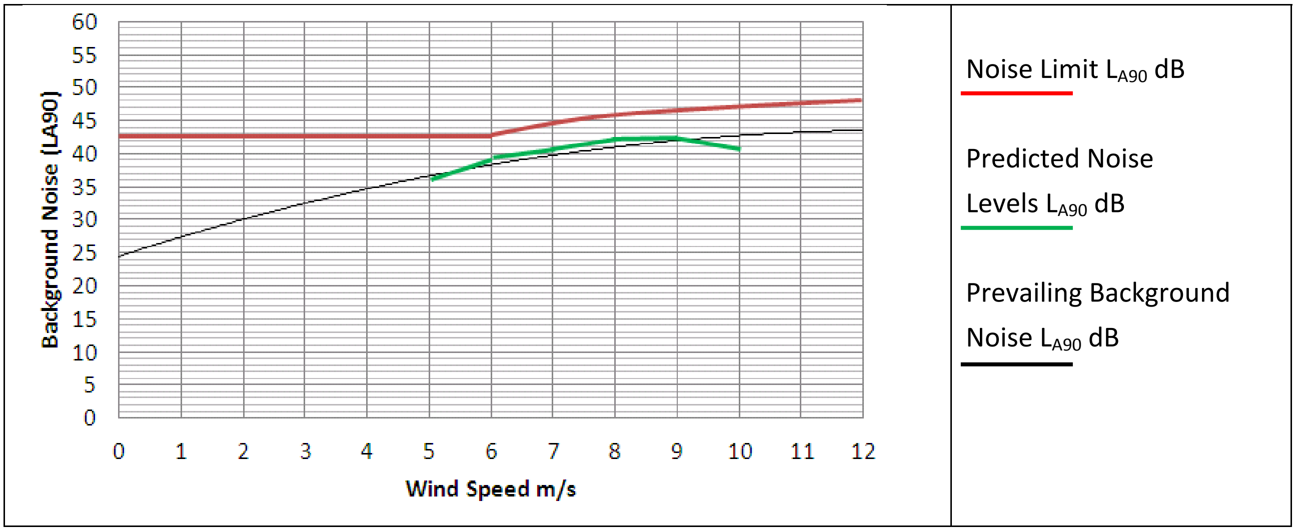
Location N7 Night time Noise Limit Curve



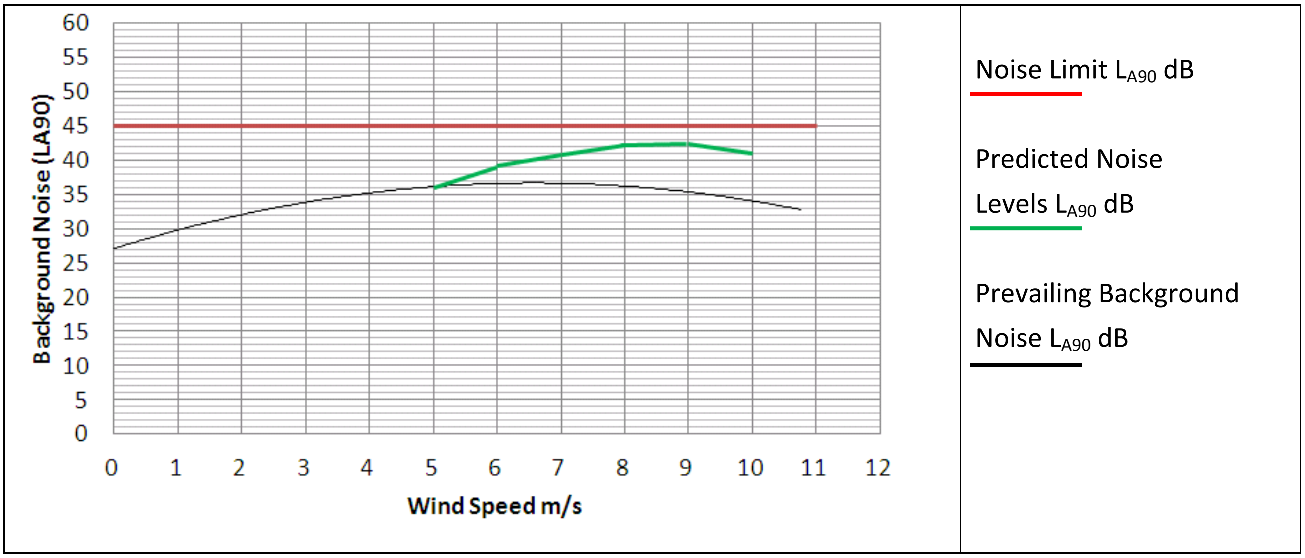
Location N8 Day time Noise Limit Curve



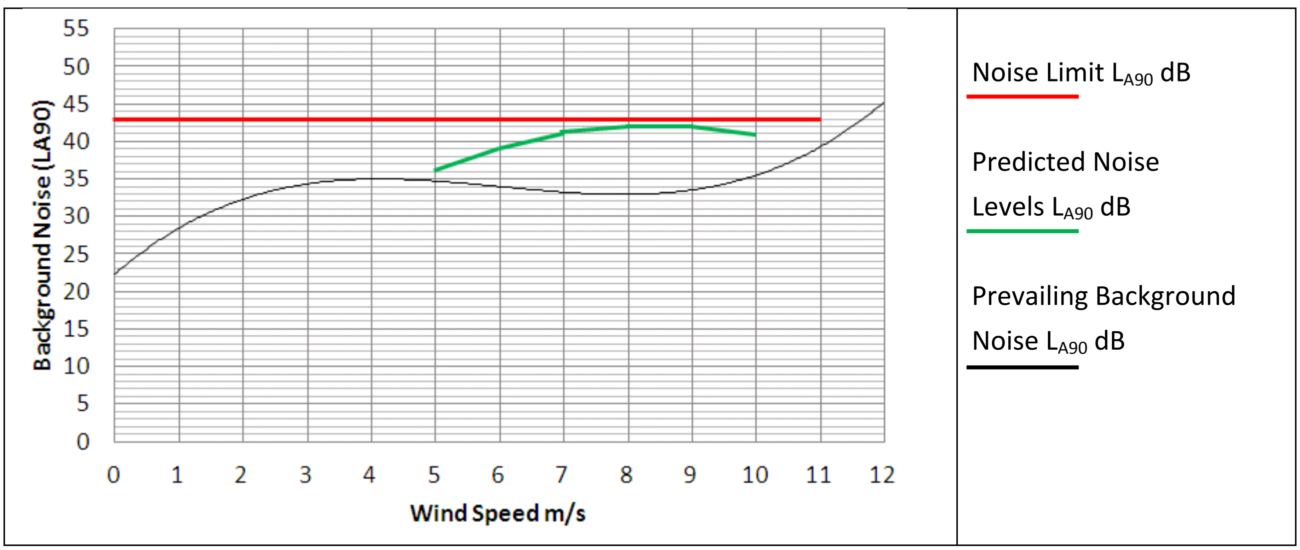
Location N8 Night time Noise Limit Curve



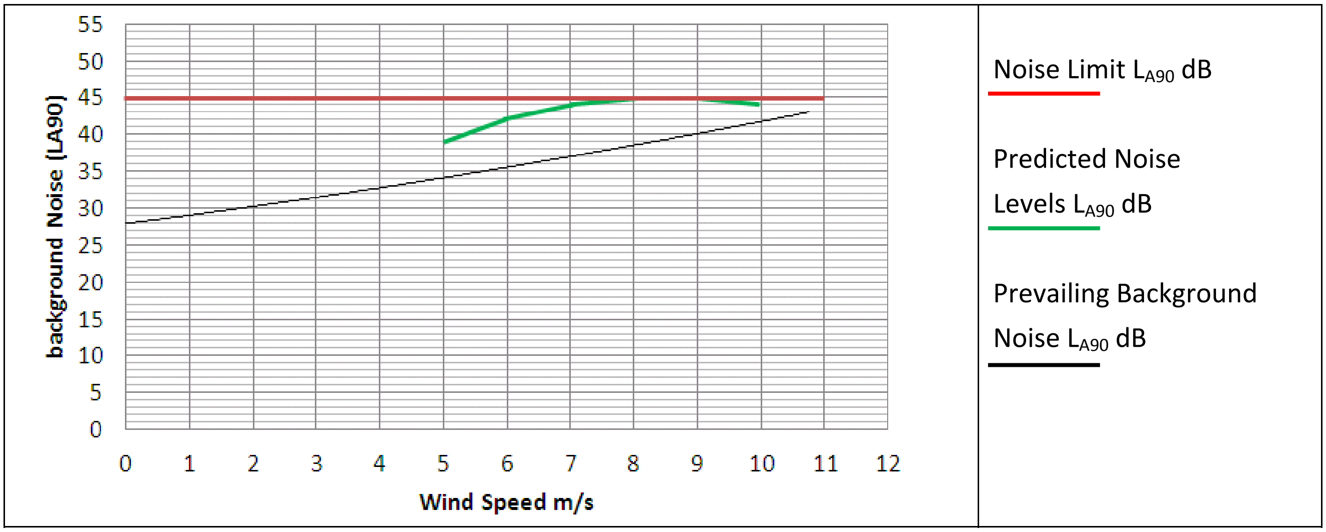
Location N9 Day time Noise Limit Curve



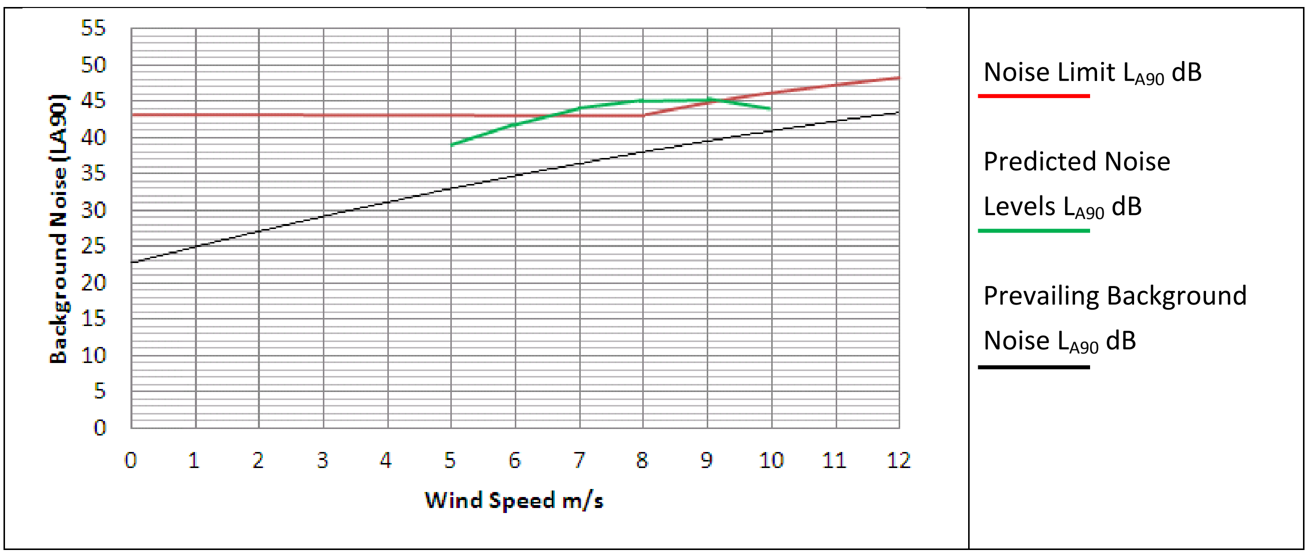
Location N9 Night time Noise Limit Curve



Location N10 Day time Noise Limit Curve



Location N10 Night time Noise Limit Curve



CHAPTER 11

LANDSCAPE AND VISUAL ASSESSMENT

UPPERCHURCH WINDFARM

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11 LANDSCAPE AND VISUAL ASSESSMENT

11.1 INTRODUCTION

This chapter describes the landscape context of the proposed Upperchurch Wind Farm and assesses the likely landscape and visual impacts of the scheme on the receiving environment. Although closely linked, landscape and visual impacts are assessed separately as the effects to the physical landscape and landscape character resulting from the development form the baseline of the assessment of visual impacts from key visual receptors.

Landscape Impact Assessment (LIA) relates to changes in the physical landscape, brought about by the proposed development, which may alter its character and how this is experienced. This requires a detailed analysis of the individual elements and characteristics of a landscape that go together make up the overall landscape character of that area. By understanding the aspects that contribute to landscape character it is possible to make judgements in relation to its quality (integrity) and to identify key sensitivities. This, in turn, provides a measure of the ability of the landscape in question to accommodate the type and scale of change associated with the proposed development, without causing unacceptable adverse changes to its character.

Visual Impact Assessment (VIA) relates to changes in the composition of views as a result of changes to the landscape, how these are perceived and the effects on visual amenity. Such impacts are population based rather than resource based as in the case of landscape impacts. Visual impacts are measured on the basis of:

- *Visual Obstruction* (blocking of a view, be it full, partial or intermittent) or;
- *Visual Intrusion* (interruption of a view without blocking).

This landscape and visual impact assessment is based on:

- Environmental Protection Agency (EPA) publication 'Guidelines on the Information to be contained in Environmental Impact Statements (2002) and the accompanying Advice Notes on Current Practice in the Preparation of Environmental Impact Statements (2003)
- Landscape Institute and the Institute of Environmental Management and Assessment publication entitled Guidelines for Landscape and Visual Impact Assessment (2002).

- Scottish Natural Heritage (SNH) Environmental Assessment Handbook –Guidance on the Environmental Impact Assessment Process Appendix 1: Landscape and Visual Impact Assessment (2011)
- Scottish Natural Heritage (SNH) Guidance Note: Cumulative Effect of Wind Farms (2005)
- Department of Environment, Heritage and Local Government (DoEHLG) 'Wind Energy Development Guidelines' (2006)

11.1.1 Statement of Authority

This assessment report was prepared by Richard Barker, Senior Landscape Architect, MosArt Landscape Architects, Wicklow. MosArt have extensive experience at both project level and strategic planning for wind farms in Ireland. A summary of relevant experience is included below:

- Assisted the Department of Environment, Heritage and Local Government (DoEHLG) in drafting the Landscape Section of the revised Wind Energy Development Guidelines (2006);
- Responsible for the landscape section of the national attitude survey to wind farms commissioned by Sustainable Energy Ireland (2003);
- Drafted the DoEHLG Landscape and Landscape Assessment Guidelines (2000);
- Completed a wind farm strategy for Waterford County Council (2004);
- Landscape character and sensitivity classification of County Cork for wind farm planning for Cork County Council (2003);
- Involved in landscape impact assessment of over 100 on-shore wind farm projects;
- Prepared the landscape impact assessment reports for the Arklow Bank, Codling Bank and Oriel offshore wind farm projects; and
- Presented papers at numerous national conferences concerning landscape assessment for strategic planning and also for the planning and design of wind farms.

11.1.2 Description of the Proposed Development

The developer proposes to locate the wind farm in an upland area west of Upperchurch. It is proposed that this development comprises of the following main elements:

- Twenty two turbines – at a maximum hub height of 90m; a maximum rotor diameter of 90m; a maximum blade tip height of 126.6m as well as associated areas of crane hardstands and foundations;
- One permanent wind measurement mast
- One Substation and compound and associated areas of hard standing;
- Access tracks – 5m wide; and
- Underground electric cabling.

11.1.3 Assessment Methodology

Production of this Landscape and Visual Impact Assessment involved desktop studies and fieldwork comprising professional evaluation by qualified and experienced Landscape Architects. This entailed the following:

11.1.3.1 Desktop Study

- Establishing an appropriate Study Area from which to study the landscape and visual impacts of the proposed wind farm;
- Review of a Zone of Theoretical Visibility (ZTV) map, which indicates areas from which the development is potentially visible in relation to terrain within the Study Area;
- Review of relevant County Development Plans, particularly with regard to sensitive landscape and scenic view/route designations;
- Selection of potential Viewshed Reference Points (VRPs) from key visual receptors to be investigated during fieldwork for actual visibility and sensitivity;
- Preparation of an initial VRP selection map from which the visualisation consultant can prepare 'wireframe images' at each potential VRP location for use during fieldwork. Wireframe images depict the proposed wind farm within the context of a basic three dimensional view of the terrain as seen from each selected VRP location.

11.1.3.2 Fieldwork

- Recording of a description of the landscape elements and characteristics within the Study Area generally and within view from each VRP.
- Selection of a refined set of VRP's for assessment. This includes the capture of panoramic photography and grid reference coordinates for each VRP location for the visualisation specialist to prepare photomontages;

11.1.3.3 Assessment

- Description of the geographic location and landscape context of the proposed wind farm site;
- General landscape description concerning essential landscape character and salient features of the Study Area, discussed with respect to; landform and drainage; vegetation and land use; centres of population and houses; transport routes and; public amenities and facilities;
- Consideration of design guidance, the planning context and relevant landscape designations.
- Assessment of predicted landscape impacts.
- Assessment of predicted visual impacts using standard ZTV maps and cumulative ZTV maps as well photomontages prepared from selected VRP locations.
- Discussion of mitigation measures.
- Assessment of residual impacts following mitigation

11.1.4 Definition of Study Area

The Wind Energy Development Guidelines published by the Department of the Environment, Heritage and Local Government specify different radii for examining the zone of theoretical visibility of proposed wind farm projects (ZTV). The extent of this search area is influenced by turbine height, on the basis that taller turbines would be visible at greater distances, as follows:

- 15km radius for blade tips up to 100m; and
- 20km radius for blade tips greater than 100m.

In the case of this project, the blade tips are 126.6m high and, thus, the ZTV radius required is 20km from the outermost turbines of the scheme. This 20km radius, therefore, defines the extent of the Study Area for this project.

11.2 EXISTING ENVIRONMENT

11.2.1 Landscape Baseline

The landscape baseline represents the existing landscape context and is the scenario against which any changes to the landscape brought about by the proposal will be assessed. This also includes reference to any relevant landscape character appraisals and the current landscape policy context (both are generally contained within County Development Plans).

A description of the landscape context of the proposed wind farm site and wider study area is provided below under the headings of landform and drainage, vegetation and land use, centres of population and houses, transport routes and public amenities and facilities and the site context. Although this description forms part of the landscape baseline many of the landscape elements identified also relate to visual receptors i.e. places and transport routes from which viewers can potentially see the proposed development. The visual resource will be described in greater detail in section 9.2.2.

11.2.1.1 Landform and Drainage

The landform of the study area is that of rolling hills at the south eastern periphery of a contiguous upland area that consists of the Slieve Felim Mountains, the Silvermines Mountains and the Devils Bit Mountains. Relatively distinctive dome shaped hills occur to the west of the site in the heart of the ranges and the highest of these are; Keeper Hill (694m a.s.l.), Mother Mountain (543m a.s.l.) and Cooneen Hill (467m a.s.l.). The upland area is the source of a number of small watercourses that tend to run directly from the ranges then trend southwards towards the larger River Shannon system. These include; the Mulkear River, the Clare River, the Owenbeg River, the Clodiagh River, and the Nenagh River.

Image 9.1 – Rolling hills and distinctive dome shaped peaks of the central portion of the study area

Image 9.2 – flat to gently undulating landscape typical of the lowlands in the north and south of the study area

11.2.1.2 Vegetation and Land Use

The landscape of the study area is a productive rural one and this is reflected in the land cover. Within the lowland landscape in the northern and southern extents of the study area the predominant land uses are pastoral farming and tillage. Pasture remains a dominant land cover within the upland areas comprising of large geometric fields defined by broadleaf hedgerows. On higher slopes and ridges commercial conifer plantations take over as the dominant land cover. Only on the upper slopes of the tallest peaks such as Keeper Hill (generally above 500m a.s.l.) is there a natural land cover of heathland. There are some small patches of broadleaf woodland within the study area as well as narrow riparian woodlands lining the banks of the numerous watercourses.

Image 9.2 – Mixed land cover of predominantly pasture and commercial conifer plantations.

11.2.1.3 Centres of Population and Houses

The largest settlements within the study area are Nenagh at the north-western periphery and Thurles at the eastern periphery. There are a number of other modest sized settlements within the plains to the east and these include; Templemore, Borrisoleigh, Ballycahill, Holycross, Clonoulty and Dundrum. The closest of these to the site is Borrisoleigh, which is approximately 7km to the northeast. Settlements within the upland area tend to be small and relatively dispersed. The nearest of these to the proposal site is Upperchurch approximately 2km to the southeast, whilst Kilcommon is 3km to the southwest and Hollyford is 6km to the south. There is a relatively high density of rural dwellings throughout the study area reflecting the productive nature of the landscape within both the lowland and upland portions.

11.2.1.4 Transport Routes

There are two principal transport routes that both pass through the outer fringes of the study area and these are the M7 motorway to the northwest and M8 motorway to the southeast. The N62 national secondary road links north-south between the settlements of Thurles and Templemore and is approximately 15km to the east of the proposal site at its nearest point. There are a number of regional roads that crisscross the study area and the closest of these to the proposal site is the R503 which traces a path around the southern half of the site and is within 2km of it for approximately 7km of its east – west journey through the uplands. The R497 links with the R503 from the south and is less than one kilometre to the south of the site at this intersection.

11.2.1.5 Public Amenities and Facilities

There is one waymarked walking route within the upland portion of the study area and this is the Slieve Felim Way. This winds through the heart of the Slieve Felim Mountains and is 10km to the west of the site at its nearest point. There are also four signposted loop walks in close proximity to the proposal site, which are part of the national loop walks initiative. These include the Knockalough, the Slí Éamoin an Cnoic, the Birch Hill and the Kilcommon Pilgrim Loop Walks.

Note: Approximately 2km beyond the south-eastern perimeter of the study area is the Rock of Cashel, which is one of Ireland's premier heritage features and tourist attractions. Given the considerable separation distance (22km) and the presence of other wind energy development in closer proximity to this heritage feature, it is not deemed necessary to consider the Rock of Cashel in terms of landscape and visual impacts herein.

11.2.1.6 Site Context

This is a relatively extensive site and thus it encompasses a rolling landscape similar to that described above at a more macro level for the upland parts of the study area. The land cover of the site is that of pastoral farmland with several blocks of commercial conifer plantation. The hills encompassed within the site that will be populated by turbines are generally in the order of 350m a.s.l. The tallest is Knockmaroe at the western edge of the site, which is 411m a.s.l. In terms of terrain this is a transitional zone as the peaks immediately to the west are are generally taller than those contained within the site whilst those to the east are generally lower. The site also encompasses the headwaters catchment of the Clodiagh River which runs out of the site to the north before veering to the east.

11.2.1.7 Landscape Policy Context and Designations

11.2.1.7.1 North Tipperary County Development Plan 2010 - 2016

A landscape character assessment was undertaken for North Tipperary County Council in 2004, which formed the basis for the North Tipperary County Council Wind Capacity Strategy and Outline Landscape Strategy adopted in 2009. The role of the County Landscape Character Assessment is described in the current County Development Plan under policy ENV2: Landscape Protection:

> *'It is the policy of the Council in assessing applications for development that would impact on landscape to balance the need to protect landscape character against the requirement for socio-economic development in accordance with value assessment and sensitivity as identified in the County Landscape Character Assessment 2009.'*

The Landscape Character Assessment sets out 12 Landscape Character Areas (LCA's) and 18 generic Landscape Character Types (LCT). The proposal site is located in LCA7 'Upperchurch – Kilcommon Hills', which contains landscape character types 6 (Farmed foothills) and 16 (Enclosed valleys). In relation to landscape condition and sensitivity for LCA7 it is stated;

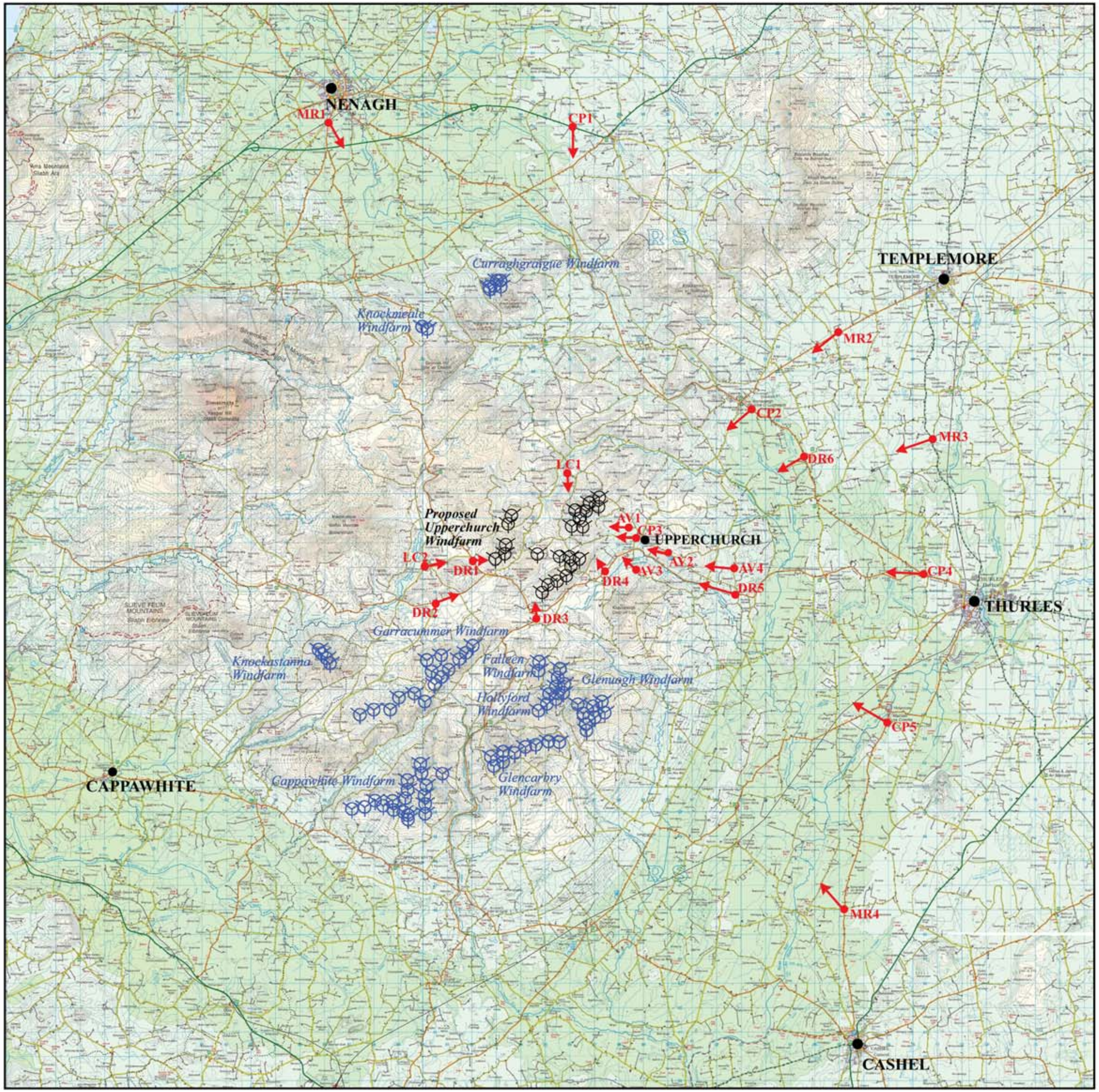
> *"This is a working landscape featuring pasture as the dominant landuse. It is in very good condition and indeed is highly scenic owing to the varied and interesting topography of rolling hills and valleys with vantage points that afford views. This high scenic quality renders this a significantly sensitive landscape. However, the nature of the varying topography is such that there is a capacity to accommodate development without undue deterioration in the scenic quality. The principal contrary factor in this landscape is the coniferous forestry. Its location on hilltops causes the maximum negative visual impact. In addition, single dwellings of inappropriate design which are poorly sited, reduce the scenic quality of this landscape in localised areas."*

In the subsequent Wind Capacity Strategy and Outline Landscape Strategy the following excerpt applies to wind energy development in LCA7 'Upperchurch – Kilcommon Hills';

> *"The farmed foothills in this landscape are very similar to those encountered in the Silvermines Character Area. In this regard, the capacity to absorb wind farm development is extensive and as previously discussed, some care is required in terms of achieving the right scale of development to match the scale of the receiving landscape. The design layout would broadly follow that prescribed for hilly and flat farmland according to the DoEHLG draft guidelines 2004. Some modification will be required to*

Figure 10.4

Map showing the location of the Viewpoint Reference Points (VRP's)



Proposed Upperchurch turbines

Existing or permitted turbines as identified on the map

CP1 Viewpoint code showing direction of the view towards the proposed Upperchurch Windfarm *this design solution and that relates to the size of the development. An increase in scale will result in a more successful layout that will respond to this landscape pattern which is bigger in scale than that found in the farmed ridges."*

11.2.1.8 South Tipperary County Development Plan (2009 – 2015)

Given the close proximity of the boundary to South Tipperary immediately to the south of the site, the wind energy policy of South Tipperary County Council is an important cross-boundary consideration. In this regard, the current Development Plan identifies the area adjacent to the site and within this upland area generally as being a *'preferred area for wind energy development'*.

11.2.2 Visual Baseline

Given the generally prominent nature of commercial wind energy developments, visual impacts tend to be a key issue for such projects. This relates both to the extent of visibility as well as the nature and degree of intrusion into views, particularly those of recognised scenic value. Only those parts of the study area that potentially afford views of the proposed wind farm are of concern to this part of the assessment. Therefore, the first part of the visual baseline is establishing a 'Zone of Theoretical Visibility' and subsequently, identifying important visual receptors from which to base the visual impact assessment.

11.2.2.1 Zone of Theoretical Visibility (ZTV) ***Figure 10.1 (over)***

Ecopower Developments Ltd. carried out a computer automated study of the zone of theoretical visibility (ZTV). The purpose of this exercise is to identify the 'theoretical' extent and degree of visibility of turbines. This is a theoretical exercise because it is based on topography only at 10m contour intervals and does not allow for intermittent screening provided by, for example, hedgerows, forests or buildings and does not involve the actual height of crests (but using the nearest 10m contour below). Thus the ZTV map, assuming no screening, represents a 'worst-case-scenario' with respect to viewing exposure. For the purposes of this project a radius of 20km was used for the ZTV as discussed earlier.

The following key points should be noted from the ZTV study:

- The ZTV map indicates that from within 5km of the proposal site theoretical visibility of the proposed turbines is fairly comprehensive. However, only from higher slopes within the site itself and from the opposing sides of surrounding valleys can all 22 of the proposed turbines be seen at once within this inner zone. The key receptors encompassed by the central ZTV pattern are the settlements of Upperchurch and Kilcommon, the R503 and R497 regional roads and the four signposted loop walks identified at 9.1.2.5 above. The entire length of the R503 and R497 regional roads contained within the first 5km from the site are designated as scenic routes and have theoretical visibility of some but not all of the proposed turbines.

- Between 5km and 10km away from the proposal site, theoretical visibility of the proposed wind farm falls away quickly due to terrain screening. Views from higher slopes and ridges remain, whilst from lower slopes and valleys there is either no view of turbines or views of a very limited number of them. The key receptors contained within the ZTV pattern in this concentric zone are the settlements of Borrisoleigh and Ballycahill, which lie at the interface of the upland and lowland zones to the east. The R498 regional road to the south of Borrisoleigh, which is also designated as a scenic route, falls within ZTV coverage in this zone.

- Between 10-15km away from the site extensive theoretical visibility has emerged in the lowland plains to the east of the site encompassing most of the settlements identified at 9.2.1.3 above as well as the N62 national secondary road. Theoretical visibility within the uplands to the north, south and west of the site is limited to the highest peaks and ridges. The only key receptor this coincides with is the Slieve Felim Way which is largely contained within commercial conifer forests at these elevations.

- At the outer periphery of the study area, between 15-20km from the proposal extensive theoretical visibility remains throughout the lowland landscape in the eastern quarters. This encompasses the settlements of Templemore and Thurles. Two further patches of visibility arise in the north western segment of the study area and one of these takes in the outskirts of Nenagh. Another occurs at the south-western periphery of the study area and encompasses the small settlement of Donohill.

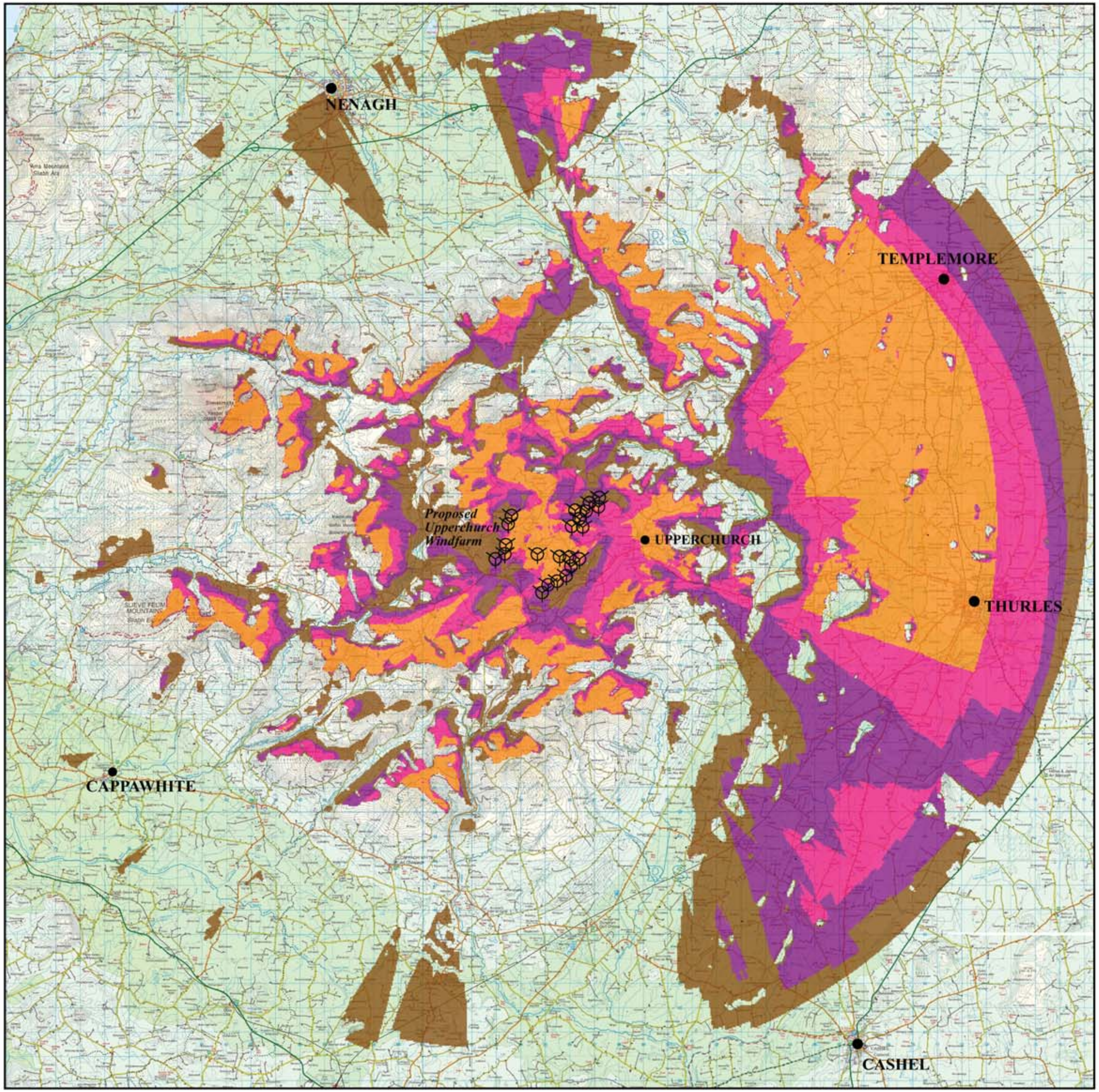


Figure 10.1

Zone of Theoretical Visibility (ZTV)
of the proposed Upperchurch turbines.

Proposed Upperchurch turbines

Colour Code:

Brown Shading: Areas where 1 - 6 Upperchurch turbines are visible (to uppermost blade tip height)

Purple Shading: Areas where 7 - 12 Upperchurch turbines are visible (to uppermost blade tip height)

Pink Shading: Areas where 13 - 18 Upperchurch turbines are visible (to uppermost blade tip height)

Orange Shading: Areas where 19 -22 Upperchurch turbines are visible (to uppermost blade tip height)

11.2.2.2 Views of Recognised Scenic Value

Views of recognised scenic value are primarily indicated within County Development plans in the context of scenic views/routes designations, but they might also be indicated on touring maps, guide books, road side rest stops or on post cards that represent the area.

11.2.2.3 North Tipperary County Development Plan (2010 – 2016)

The North Tipperary County Development Plan identifies 15 protected views, which are all from sections of road. Those relevant to this proposal are identified below;

V11 *Views north and south of the R498 from Bouladuff through Borrisoleigh to Latteragh*

V12 *Views north and south on sections of the R503 from Newport to Ballycahill*

V13 *Views east and west of the R497 from the R503 through the mountains to Dolla – including Mother Mountain to the West, Knockacreggan to the East, Cooneen Hill to the East and the Silvermines to the west*

V15 *Views west on the N62 north of Templemore*

11.2.2.4 South Tipperary County Development Plan (2009 – 2015)

Designated scenic views from within South Tipperary are also relevant to this proposal given the close proximity of the jurisdictional boundary immediately to the south of the site. The only relevant scenic route identified within the South Tipperary County Development Plan is identified below;

V036 *Views in all directions from Ironmills to Milestone Road (R497)*

11.2.2.5 Limerick County Development Plan (2010 – 2016)

There are no relevant designated scenic views from the small section of County Limerick that is contained within the south-western quarter of this study area.

11.2.2.6 Identification of Viewshed Reference Points as a Basis for Assessment ***Figure 10.4 (over)***

The results of the ZTV analysis provide the basis for selection of Viewshed Reference Points (VRP's), which are the locations used to study the landscape and visual impact of the proposed wind farm in detail. It is not warranted to include each and every location that provides a view of this development as this would result in an unwieldy report and make it extremely difficult to draw out the key impacts arising from the project. Instead, the assessors endeavoured to select a variety of location types that would provide views of the proposed wind farm from different distances, different angles and different contexts.

The visual impact of a proposed development is assessed using up to 6 categories of receptor type as listed below;

- **Key Views (**from features of national or international importance)**;**
- **Designated Scenic Routes and Views;**
- **Local Community views;**
- **Centres of Population;**
- **Major Routes; and**
- **Amenity and heritage features;**

Where a VRP might have been initially selected for more than one reason it will be assessed according to the primary criteria for which it was chosen. The characteristics of each receptor type vary as does the way in which the view is experienced. These are described below.

11.2.2.6.1 Key Views

These VRP's are at features or locations that are significant at the national or even international level, typically in terms of heritage, recreation or tourism. They are locations that attract a significant number of viewers who are likely to be in a reflective or recreational frame of mind possibly increasing their appreciation of the landscape around them. The location of this receptor type is usually quite specific.

11.2.2.6.2 Designated Scenic Routes and Views

Due to their identification in the County Development Plan this type of VRP location represents a general policy consensus on locations of high scenic value within the Study Area. These are commonly elevated, long distance, panoramic views and may or may not be mapped from precise locations. They are more likely to be experienced by static viewers who seek out or stop to take in such vistas.

11.2.2.6.3 Local Community Views

This type of VRP represents those people that live and/or work in the locality of the wind farm, usually within a 5km radius of the site. Although the VRP's are generally located on local level roads they also represent similar views that may be available from adjacent houses. The precise location of this VRP type is not critical, however, clear elevated views are preferred, particularly when closely associated with a cluster of houses and representing their primary views. Coverage of a range of viewing angles using several VRP's is necessary in order to sample the spectrum of views that would be available from surrounding dwellings.

11.2.2.6.4 Centres of Population

VRP's are selected at centres of population primarily due to the number of viewers that are likely to experience that view. The relevance of the settlement is based on the significance of its size in terms of the Study Area or its proximity to the site. The VRP may be selected from any location within the public domain that provides a clear view either within the settlement or in close proximity to it.

11.2.2.6.5 Major Routes

These include national and regional level roads and rail lines and are relevant VRP locations due to the number of viewers potentially impacted by the proposed development. The precise location of this category of VRP is not critical and might be chosen anywhere along the route that provides clear views towards the proposal site, but with a preference towards close and/or elevated views. Major routes typically provide views experienced whilst in motion and these may be fleeting and intermittent depending on screening by intervening vegetation or buildings.

11.2.2.6.6 Amenity and Heritage Features

These views are often one and the same given that heritage locations are often important tourist and visitor destinations and amenity areas or walking routes are commonly designed to incorporate heritage features. Such locations or routes tend to be sensitive to development within the landscape as viewers are likely to be in a receptive frame of mind with respect to the landscape around them. The sensitivity of this type of visual receptor is strongly related to the number of visitors they might attract and, in the case of heritage features, whether these are discerning experts or lay tourists. Sensitivity is also heavily influenced by the experience of the viewer at a heritage site as distinct from simply the view of it. This is a complex phenomenon that is likely to be different for every site. Experiential considerations might relate to the sequential approach to a castle from the car park or the view from a hilltop monument reached after a demanding climb. It might also relate to the influence of contemporary features within a key view and whether these detract from a sense of past times. It must also be noted that the sensitivity rating attributed to a heritage feature for the purposes of a landscape and visual assessment is not synonymous with its importance to the Archaeological or Architectural Heritage record.

Table 9-1 Outline Description of Selected Viewshed Reference Points (VRPs)

VRP No.	*Location*	*Direction of view*
CP1	Toomyvara	SE
CP2	Borrisoleigh	SW
CP3	Upperchurch	W
CP4	Thurles	W
CP5	Holycross	NW
LC1	Local road at Garranakilka	S
LC2	Kilcommon Village	E
MR1	Nenagh	SE
MR2	R501 Borrisoleigh - Templemore Road	SW
MR3	N62 Thurles -Templemore Road	SW
MR4	R660 at Boherlahan	NW
DR1	Curreeny Road	NE
DR2	Anglesey Road at Loughbrack	NE
DR3	Anglesey Road at Milestone	N
DR4	R503 at Ruan	NW
DR5	Anglesey Road at Rossoulty	NW
DR6	R498 at The Ragg/Inch	W
AV1	Slí Éamoin an Cnoic	W
AV2	Ballyboy lookout point	W
AV3	Knockalough looped walk	NW
AV4	Birch Hill looped walk	W

11.3 LIKELY SIGNIFICANT IMPACTS

11.3.1 Landscape Impact

11.3.1.1 Assessment Criteria

When assessing the potential impacts on the landscape resulting from a wind farm development, the following criteria are considered:

- landscape character, value and sensitivity
- Magnitude of likely impacts; and
- Significance of landscape effects

The sensitivity of the landscape to change is the degree to which a particular landscape receptor (Landscape Character Area (LCA) or feature) can accommodate changes or new features without unacceptable detrimental effects to its essential characteristics. Landscape Value and Sensitivity is classified using the following criteria;

Table 9-2 Landscape Value and Sensitivity

Sensitivity	Description
Very High	Areas where the landscape character exhibits a very low capacity for change in the form of development. Examples of which are high value landscapes, protected at an international or national level (World Heritage Site/National Park), where the principal management objectives are likely to be protection of the existing character.
High	Areas where the landscape character exhibits a low capacity for change in the form of development. Examples of which are high value landscapes, protected at a national or regional level (Area of Outstanding Natural Beauty), where the principal management objectives are likely to be considered conservation of the existing character.
Medium	Areas where the landscape character exhibits some capacity and scope for development. Examples of which are landscapes which have a designation of protection at a county level or at non-designated local level where there is evidence of local value and use
Low	Areas where the landscape character exhibits a higher capacity for change from development. Typically this would include lower value, non-designated landscapes that may also have some elements or features of recognisable quality, where landscape management objectives include, enhancement, repair and restoration.
Negligible	Areas of landscape character that include derelict, mining, industrial land or are part of the urban fringe where there would be a reasonable capacity to embrace change or the capacity to include the development proposals. Management objectives in such areas could be focused on change, creation of landscape improvements and/or restoration to realise a higher landscape value.

The magnitude of a predicted landscape impact is a product of the scale, extent or degree of change that is likely to be experienced as a result of the proposed development. The magnitude takes into account whether there is a direct physical impact resulting from the loss of landscape components and/or a change that extends beyond the proposal site boundary that may have an effect on the landscape character of the area.

Table 9-3 Magnitude of Landscape Impacts

Magnitude of Impact	Description
Very High	Change that would be large in extent and scale with the loss of critically important landscape elements and features, that may also involve the introduction of new uncharacteristic elements or features that contribute to an overall change of the landscape in terms of character, value and quality.
High	Change that would be more limited in extent and scale with the loss of important landscape elements and features, that may also involve the introduction of new uncharacteristic elements or features that contribute to an overall change of the landscape in terms of character, value and quality.
Medium	Changes that are modest in extent and scale involving the loss of landscape characteristics or elements that may also involve the introduction of new uncharacteristic elements or features that would lead to changes in landscape character, and quality.
Low	Changes affecting small areas of landscape character and quality, together with the loss of some less characteristic landscape elements or the addition of new features or elements.
Negligible	Changes affecting small or very restricted areas of landscape character. This may include the limited loss of some elements or the addition of some new features or elements that are characteristic of the existing landscape or are hardly perceivable.

The significance of a landscape impact is based on a balance between the sensitivity of the landscape receptor and the magnitude of the impact. The significance of landscape impacts is arrived at using the following matrix;

Table 9-4 Landscape Impact Significance Matrix

	Sensitivity of Receptor				
Scale/Magnitude	*Very High*	*High*	*Medium*	*Low*	*Negligible*
Very High	Profound	Profound-major	Major	Moderate	Minor
High	Profound-major	Major	Major-moderate	Moderate-minor	Minor-negligible
Medium	Major	Major-moderate	Moderate	Minor	Negligible
Low	Moderate	Moderate-minor	Minor	Minor-negligible	Negligible
Negligible	Minor	Minor-negligible	Negligible	Negligible	Negligible

Note that potential beneficial landscape impacts are not accounted for in the tables and matrix above. In the rare instances that this might occur, perhaps by facilitating the rehabilitation of a degraded landscape, the benefits will be discussed in the assessment and the significance of impact would default to the lowest end of the range (negligible).

11.3.1.2 Landscape Character, Value and Sensitivity

Effects on landscape character will be considered at both the localised scale of the site and its immediately surrounding landscape as well as the broader scale of the study area.

In the near vicinity of the proposal site (within approximately 5km) the landscape comprises of steeply rolling hills and valleys with a mixed land cover of pastoral grazing and commercial forests. The existing Glenough wind farm also occurs just to the southwest. This landscape is also influenced by the R503 and R497 regional roads, a network of local roads and small settlements such as Upperchurch, Milestone and Kilcommon, which give it an anthropogenic character. Nonetheless, this character is that of remote rural uplands.

The landscape character of the wider study area (beyond approximately 5km) is very similar to that described above, particularly within the upland areas to the north, south and west. Forest plantations begin to dominate grazing land as the predominant land use within the heart of the ranges to the west and several wind farms also occur in this area.

The landscape character changes markedly as the hills give way to the flat lowland plains fairly abruptly to the northwest and southeast. The plains are characterised by a higher intensity of rural and built development as well as a higher settlement density. This is centred on evenly dispersed, modest scale settlements, which act as rural service centres. The major transport corridors of the M7 and M8 motorways influence the landscape character at the north-western and south-eastern fringes of the study area respectively. The mountains ranges that occupy the heart of the study area act as a distinctive undulating backdrop to the plains giving these otherwise unremarkable rural lowlands something of a sense of place. Wind turbines that can be seen above the ridgeline also contribute to the character of this backdrop. Overall it is considered that the landscape character of the lowland plains is a strongly anthropogenic one of intensive agriculture.

Due to the reasons outlined above, and particularly the presence of existing wind farms, the landscape sensitivity of the site and its immediate surrounds as well as the wider study area is deemed to be **low**.

11.3.1.3 Magnitude of Landscape Effects

The physical landscape as well as the character of the site and its immediate surrounds is affected by the proposed turbines as well as ancillary development such as access and circulation roads, areas of hard standing for the turbines, the permanent meteorological mast and the substation. By contrast, for the wider landscape of the study area, landscape impacts relate almost exclusively to the influence of the proposed turbines on landscape character.

It is considered that the proposed wind farm development will have only a minor physical impact on landscape components within the site as none of the proposed development features (turbines, substation, anemometer mast) have a significant 'footprint'. The topography of the site will remain unaltered with excavation being limited to establishment of some additional tracks and areas of hard standing for the turbines. Such excavation will tie into the existing contours and will be the minimum required for safe working. Any temporary stockpiles of material will be re-graded to marry into existing site levels. Similarly, the land cover of the site will only be interrupted as necessary to create tracks and areas of hard standing for the turbines. It is estimated that 4.35ha of existing conifer plantation will need to be clear-felled in order to construct the wind farm. The current pastoral farming regime will continue below the wind turbines without significant disruption following the construction phase.

The principal landscape impact will be the change in character of the immediate area due to the introduction of large scale structures with moving components. These will be a prominent landscape feature within the local landscape as would be the case for a commercial scale wind farm placed into almost any landscape context. However, the turbines will not represent a new and unfamiliar feature even in this localised area as the 14 turbine Glenough Wind Farm occurs only 3.2km away to the south of the proposal site. There are also two wind farms currently under construction in the near vicinity of the proposal including the 15 turbine Garracummer scheme (3.5km to the southwest) and the 2 turbine Falleen development (2.8km to the south). Therefore, the proposal represents a further intensification of wind energy development, which has considerably less effect on the landscape character than an initial introduction of turbines would have. Indeed, wind energy development is emerging as one of the defining land uses in the central study area irrespective of the proposed development.

The height of the proposed turbines and the overall scale of the wind farm, although relatively substantial, is not considered excessive in this landscape context due to the scale of the terrain and the relatively broad land use patterns in the vicinity. This is reflected in the North Tipperary 'Wind Capacity and Outline Landscape Strategy', which seeks a broad scale of wind energy development in this Landscape Character Area to reflect the nature of the landscape (see 9.2.1.7.1 above).

Although the wind farm represents a slightly increased sense of human intervention and level of built development than currently exists on the site or in the immediate area, it will not detract significantly from the relatively remote, rural character. This is on the basis that wind farms are regularly located in such areas and have become somewhat synonymous with remote rural locations. This perception is also aided by the fact that a generally low level of site activity occurs during the operational phase of a wind farm development.

Site activity will be at its greatest during the construction phase due to the operation of machinery on site and movement of heavy vehicles to and from site. This phase will have a more significant impact on the character of the site, but it is a temporary impact that will cease upon completion of the scheme (6-8 months).

It is important to note that in terms of duration, this wind farm proposal represents a long term, but not permanent impact on the landscape. The lifespan of the project is 25 years, after which time it will be dismantled and the landscape reinstated to prevailing conditions. Nonetheless, this is a significant period of time and it might be argued that if the development remains viable an application could be made to extend its lifecycle or an alternative development proposed on the basis of an established use on this site. Subsequent use of the site is difficult for anyone to predict and is not part of this assessment. Instead, the key point is that a wind farm development has a fairly 'light footprint' on the landscape in comparison to a quarry or road development, for example. Within a couple of years of decommissioning there would be little evidence that a wind farm ever existed on the site.

Within the wider landscape context there are two other existing wind farms including Curraghgraigue 9.5km to the north and Knockstanna (4 turbines) just over 8km to the south. These contribute the character of the upland landscape in which they sit and as a background feature they also influence the character of the surrounding lowland plains. Again, the proposed development represents the intensification of an established land use and it will contribute to wind energy development becoming one of the defining elements of the landscape character of the wider study area.

For the reasons outlined above, the magnitude of the landscape impact is deemed to be **low.**

In accordance with the significance matrix, a 'low' sensitivity judgement coupled with an impact magnitude of 'low' results in a **Minor-negligible** significance of landscape impact.

11.3.2 Visual Impact

As with the landscape impact, the visual impact of the proposed wind farm will be assessed as a function of sensitivity versus magnitude. In this instance the sensitivity of the visual receptor, weighed against the magnitude of the visual effect.

11.3.2.1 Sensitivity of Visual Receptors

Unlike landscape sensitivity, the sensitivity of visual receptors has an anthropocentric basis. It considers factors such as the perceived quality and values associated with the view, the landscape context of the viewer, the likely activity they are engaged in and whether this heightens their awareness of the surrounding landscape. A list of the factors considered by MosArt in estimating the level of sensitivity for a particular visual receptor is outlined below and used in table 9-6 to establish visual receptor sensitivity at each VRP:

1. **Recognised scenic value of the view** (County Development Plan designations, guidebooks, touring maps, postcards etc). These represent a consensus in terms of which scenic views and routes within an area are strongly valued by the population because in the case of County Developments Plans, at least, a public consultation process is required;

2. **Views from within highly sensitive landscape areas**. Again, highly sensitive landscape designations are usually part of a county's Landscape Character Assessment, which is then incorporated with the County Development Plan and is therefore subject to the public consultation process. Viewers within such areas are likely to be highly attuned to the landscape around them;

3. **Primary views from dwellings**. A proposed development might be seen from anywhere within a particular residential property with varying degrees of sensitivity. Therefore, this category is reserved for those instances in which the design of dwellings or housing estates, has been influenced by the desire to take in a particular view. This might involve the use of a slope or the specific orientation of a house and/or its internal social rooms and exterior spaces;

4. **Intensity of use, popularity**. This relates to the number of viewers likely to experience a view on a regular basis and whether this is significant at county or regional scale;

5. **Connection with the landscape**. This considers whether or not receptors are likely to be highly attuned to views of the landscape i.e. commuters hurriedly driving on busy national

route versus hill walkers directly engaged with the landscape enjoying changing sequential views over it;

6. **Provision of elevated panoramic views**. This relates to the extent of the view on offer and the tendency for receptors to become more attuned to the surrounding landscape at locations that afford broad vistas.

7. **Sense of remoteness and/or tranquillity.** Receptors taking in a remote and tranquil scene, which is likely to be fairly static, are likely to be more receptive to changes in the view than those taking in the view of a busy street scene, for example;

8. **Degree of perceived naturalness**. Where a view is valued for the sense of naturalness of the surrounding landscape it is likely to be highly sensitive to visual intrusion by distinctly manmade features;

9. **Presence of striking or noteworthy features.** A view might be strongly valued because it contains a distinctive and memorable landscape feature such as a promontory headland, lough or castle;

10. **Historical, cultural and / or spiritual significance.** Such attributes may be evident or sensed by receptors at certain viewing locations, which may attract visitors for the purposes of contemplation or reflection heightening the sense of their surroundings;

11. **Rarity or uniqueness of the view**. This might include the noteworthy representativeness of a certain landscape type and considers whether the receptor could take in similar views anywhere in the broader region or the country;

12. **Integrity of the landscape character**. This looks at the condition and intactness of the landscape in view and whether the landscape pattern is a regular one of few strongly related components or an irregular one containing a variety of disparate components;

13. **Sense of place**. This considers whether there is special sense of wholeness and harmony at the viewing location; and

Upperchurch Windfarm Enviromental Impact Statement

14. **Sense of awe**. This considers whether the view inspires an overwhelming sense of scale or the power of nature.

Those locations which are deemed to satisfy many of the above criteria are likely to be in the higher order of magnitude in terms of sensitivity and vice versa. No relative importance is inferred by the order of listing in the table 9-5 below. Overall sensitivity may be a result of a number of these factors or, alternatively, a strong association with one or two in particular.

Table 9-5 Analysis of Visual Receptor Sensitivity at Viewshed Reference Points

Assessment Criteria	**CP1**	**CP2**	**CP3**	**CP4**	**CP5**	**LC1**	**LC2**	**MR1**	**MR2**	**MR3**	**MR4**	**DR1**	**DR2**	**DR3**	**DR4**	**DR5**	**DR6**	**AV1**	**AV2**	**AV3**	**AV4**
Recognised scenic value of the view	N	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y	N	Y	N	N
Views from within highly sensitive landscape areas	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Primary views from residences	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Intensity of use, popularity (number of viewers)	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Viewer connection with the landscape	N	N	N	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Provision of vast, elevated panoramic views	N	N	N	Y	N	Y	N	Y	Y	N	Y	N	Y	Y	N	N	Y	N	Y	N	Y
Sense of remoteness and/or tranquillity at the viewing location	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	Y
Degree of perceived naturalness	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

Presence of striking or noteworthy features	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Sense of Historical, cultural and / or spiritual significance	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Rarity or uniqueness of the view	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Integrity of the landscape character within the view	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Sense of place at the viewing location	N	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	Y	Y	N	N
Sense of awe	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	Y	N	N
Overall sensitivity assessment	**L**	**L**	**L**	**L**	**L**	**M**	**M**	**L**	**L**	**L**	**L**	**M**	**M**	**M**	**M**	**M**	**M**	**M**	**H**	**M**	**M**

Notes: **N** implies 'no', the VRP is generally not sensitive with respect to the assessment criterion, whereas **Y** implies 'yes' it is sensitive

N = Negligible; **L** = low sensitivity; **M** = medium sensitivity; **H** = high sensitivity; **VH** = very high sensitivity

11.3.2.2 Visual Impact Magnitude

The magnitude of visual effects is determined on the basis of two factors; the visual presence of the proposal and its effect on visual amenity.

Visual presence is something of a quantitative measure relating to how noticeable or visually dominant the proposal is within a particular view. This is based on a number of aspects beyond simply scale in relation to distance. Some of these include the extent of the view as well as its complexity and the degree of movement experienced i.e. within a busy street scene. The backdrop against which the development is presented and its relationship with other focal points or prominent features within the view is also considered. Visual presence is essentially a measure of the relative visual dominance of the proposal within the available vista and is often expressed as such i.e. sub-dominant, co-dominant, dominant, highly dominant.

For wind energy developments a strong visual presence is not necessarily synonymous with adverse impact as might be the case for a factory, a road or electricity pylons, for which the general consensus is likely to be almost wholly negative. Instead, the 2003 SEI funded survey of 'Attitudes Towards The Development of Wind Farms in Ireland' found that *"wind farms are seen in a positive light compared to other utility-type structures that could be built on the landscape"*. Furthermore, a clear and comprehensive view of a wind farm might be preferable in many instances to a partial and confusing view of turbine components that are not so noticeable within a view. On the basis of these reasons, the visual amenity aspect of assessing impact magnitude is qualitative and considers such factors as the spatial arrangement of turbines both within the scheme and in relation to surrounding terrain and land cover. It also examines whether the development contributes positively to the existing qualities of the vista or results in distracting visual effects and disharmony.

It should be noted that as a result of this two-sided analysis, a high order visual presence can be moderated by a low level of effect on visual amenity and vice versa. Given that wind turbines do not represent significant bulk, visual impacts result almost entirely from visual 'intrusion' rather than visual 'obstruction' (the blocking of a view). The magnitude of visual impacts is classified in the following table;

Table 9-6 Magnitude of Visual Impact

Criteria	Description
Very High	The proposal intrudes into a large proportion or critical part of the available vista and is without question the most noticeable element. A high degree of visual clutter or disharmony is also generated, strongly reducing the visual amenity of the scene
High	The proposal intrudes into a significant proportion or important part of the available vista and is one of the most noticeable elements. A considerable degree of visual clutter or disharmony is also likely to be generated, appreciably reducing the visual amenity of the scene
Medium	The proposal represents a moderate intrusion into the available vista, is a readily noticeable element and/or it may generate a degree of visual clutter or disharmony, thereby reducing the visual amenity of the scene. Alternatively, it may represent a balance of higher and lower order estimates in relation to visual presence and visual amenity
Low	The proposal intrudes to a minor extent into the available vista and may not be noticed by a casual observer and/or the proposal would not have a marked effect on the visual amenity of the scene
Negligible	The proposal would be barely discernible within the available vista and/or it would not detract from, and may even enhance, the visual amenity of the scene

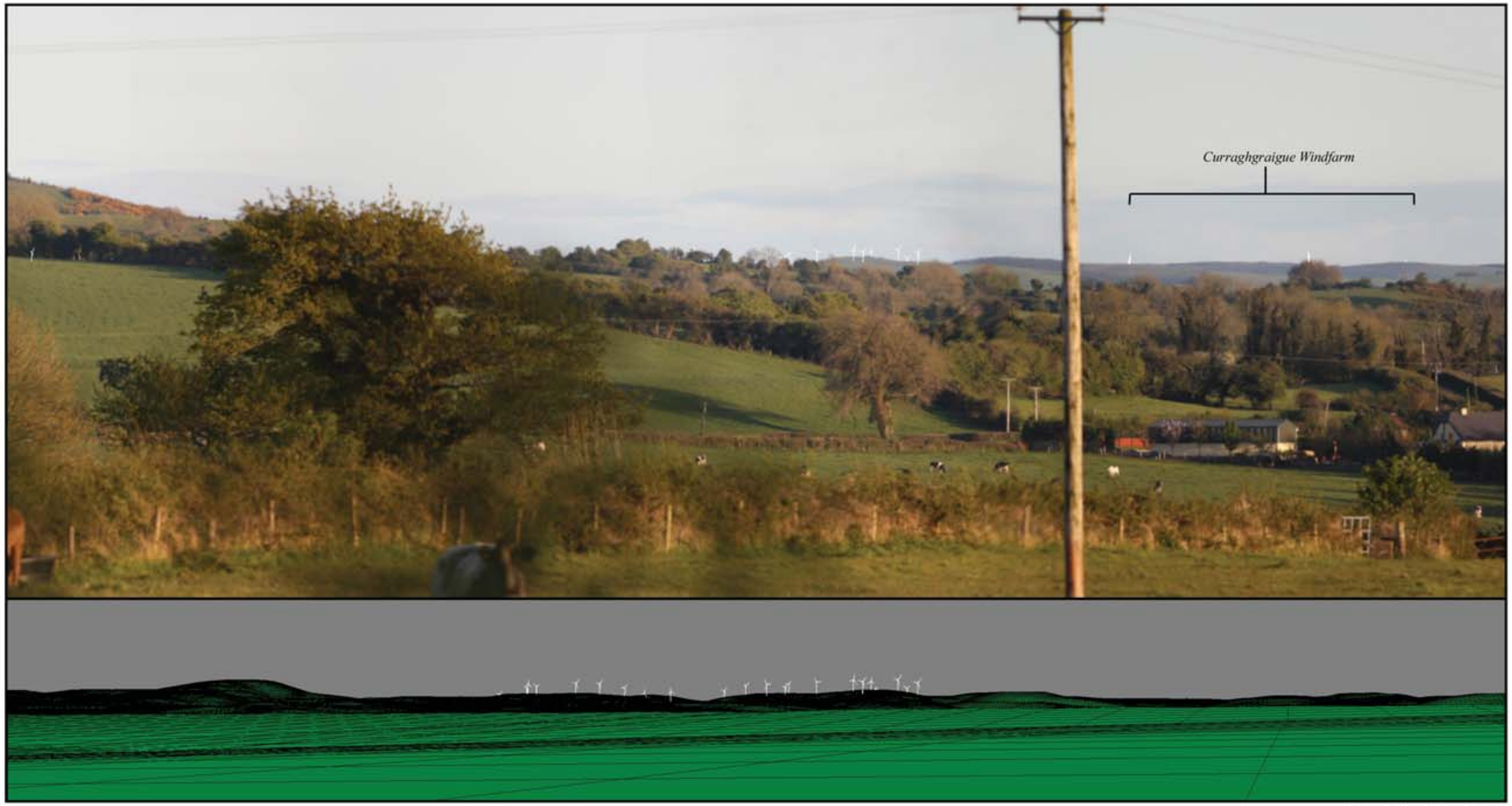
11.3.2.3 Visual Impact Significance

As stated above, the significance of visual impacts is a function of visual receptor sensitivity and visual impact magnitude. This relationship is expressed in the following significance matrix;

Table 9-7 Visual Impact Significance Matrix

	Sensitivity of Receptor				
Scale/Magnitude	*Very High*	*High*	*Medium*	*Low*	*Negligible*
Very High	Profound	Profound-major	Major	Moderate	Minor
High	Profound-major	Major	Major-moderate	Moderate-minor	Minor-negligible
Medium	Major	Major-moderate	Moderate	Minor	Negligible
Low	Moderate	Moderate-minor	Minor	Minor-negligible	Negligible
Negligible	Minor	Minor-negligible	Negligible	Negligible	Negligible

CP1: View from Toomevara



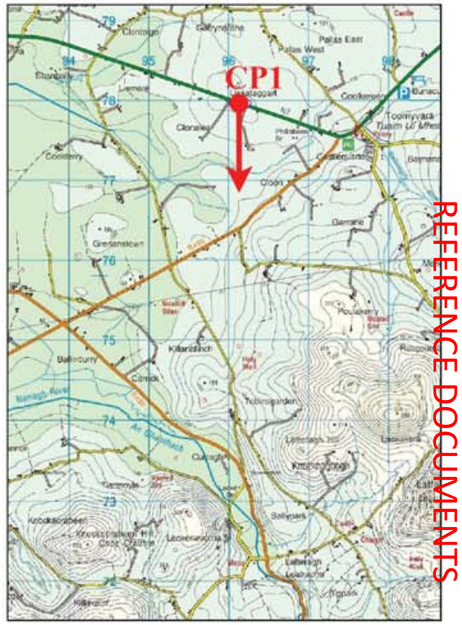
Focal lenght: 50mm
Recommended viewing distance: 39cm

Photomontage and wireframe depiction of the proposed Upperchurch wind farm

CP1

CP1: Toomevara

CP1 Grid Reference:	E196146 N177960
Viewpoint elevation	132m
Nearest proposed Upperchurch turbine	15.2km
No. proposed Upperchurch turbine hubs visible	12
No. proposed Upperchurch turbine blade sets visible	12
Direction of view	S



Panned view showing the cumulative visual influence of the proposed Upperchurch turbines with the existing and permitted wind farms in the area in a landscape context

11.3.2.4 Estimation of Visual Impacts at VRPs

Viewshed Reference Point		Direction of View	Distance to nearest turbine:	Number of turbine hubs visible:
CP1	Toomevara	S	15.2	12

Representative of:

- An area identified on the ZTV map as having a theoretical view of 19-22 of the proposed turbines
- A settlement
- A regional road

Receptor Sensitivity **Low**

Existing View

This is a slightly elevated and fairly broad panorama that is interrupted somewhat by roadside vegetation. Across a flat pastoral landscape of large geometric fields and broadleaf hedgerows can be seen two distinctive sets of hills. The one to the left is the Devils Bit range and to the right is the northern extent of the Silvermines range. A broad saddle lies between the higher undulating ridgelines of these two linked sets of hills. Several turbines from the Curraghgraigue wind farm can be faintly seen in the base of this saddle.

Visual Impact of Upperchurch Wind Farm

Some of the proposed turbines will be just visible in the base of the low saddle between the sets of hills described above. Only the western end of the scheme can be seen above a band on intervening vegetation and these also rise above the skyline so that they are faintly seen in silhouette against the sky. At this distance the turbines are seen at a very small scale. They are also oblique to the road and within a relatively complex vista, which makes them a barely noticeable feature.

The visible turbines are seen in an unambiguous manner with a staggered linear layout and an undulating profile that complements the terrain and land cover patterns within the view. The turbines represent an extension and intensification of wind energy development in this portion of the view and are not, therefore, an unfamiliar element. Overall the magnitude of visual impact is deemed to be negligible.

Summary

Based on the assessment criteria and matrices outlined at section 9.3.2 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Low	Negligible	**Negligible**

CP2: View from Borrisoleigh

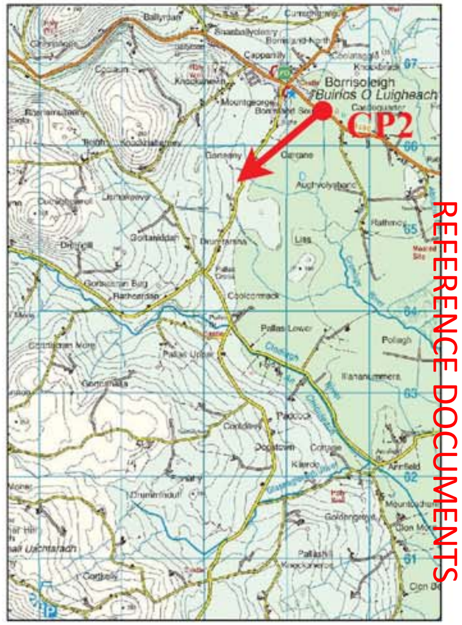
Photomontage and wireframe depiction of the proposed Upperchurch wind farm

Focal lenght: 50mm
Recommended viewing distance: 39cm

CP2

CP2: Borrisoleigh

CP2 Grid Reference:	E203435 N166415
Viewpoint elevation	100m
Nearest proposed Upperchurch turbine	7.2km
No. proposed Upperchurch turbine hubs visible	13
No. proposed Upperchurch turbine blade sets visible	14
Direction of view	SW



Panned view showing the cumulative visual influence of the proposed Upperchurch turbines with the existing and permitted wind farms in the area in a landscape context

Viewshed Reference Point		**Direction of View**	**Distance to nearest turbine:**	**Number of turbine hubs visible:**
CP2	Borrisoleigh	SW	7.2km	13

Representative of:

- An area identified on the ZTV map as having a theoretical view of between 13 and 18 of the proposed turbines
- A centre of population
- A regional road

Receptor Sensitivity **Low**

Existing View

This is a view towards the Slieve Felim mountains from the outskirts of Borrisoleigh. The foreground of the view is transitional in character with fields and hedgerows to the left and the built environment of the village to the right. An open field defined by mature broadleaf trees lies directly in front of the viewer. These trees limit the view of the surrounding hills so that only sections of the undulating ridgeline are apparent.

Visual Impact of Upperchurch Wind Farm

The proposed turbines are seen in two dense clusters within the tops of the intervening trees and above the more distant skyline ridge. Whilst the overlapping of several of the turbines might draw attention as the blades cross over each other, the scheme is relatively camouflaged by the foreground trees. The blade sets of the turbines are seen at a modest scale from this distance and within a broad vista. The visual presence of the scheme is considered to be sub-dominant from here.

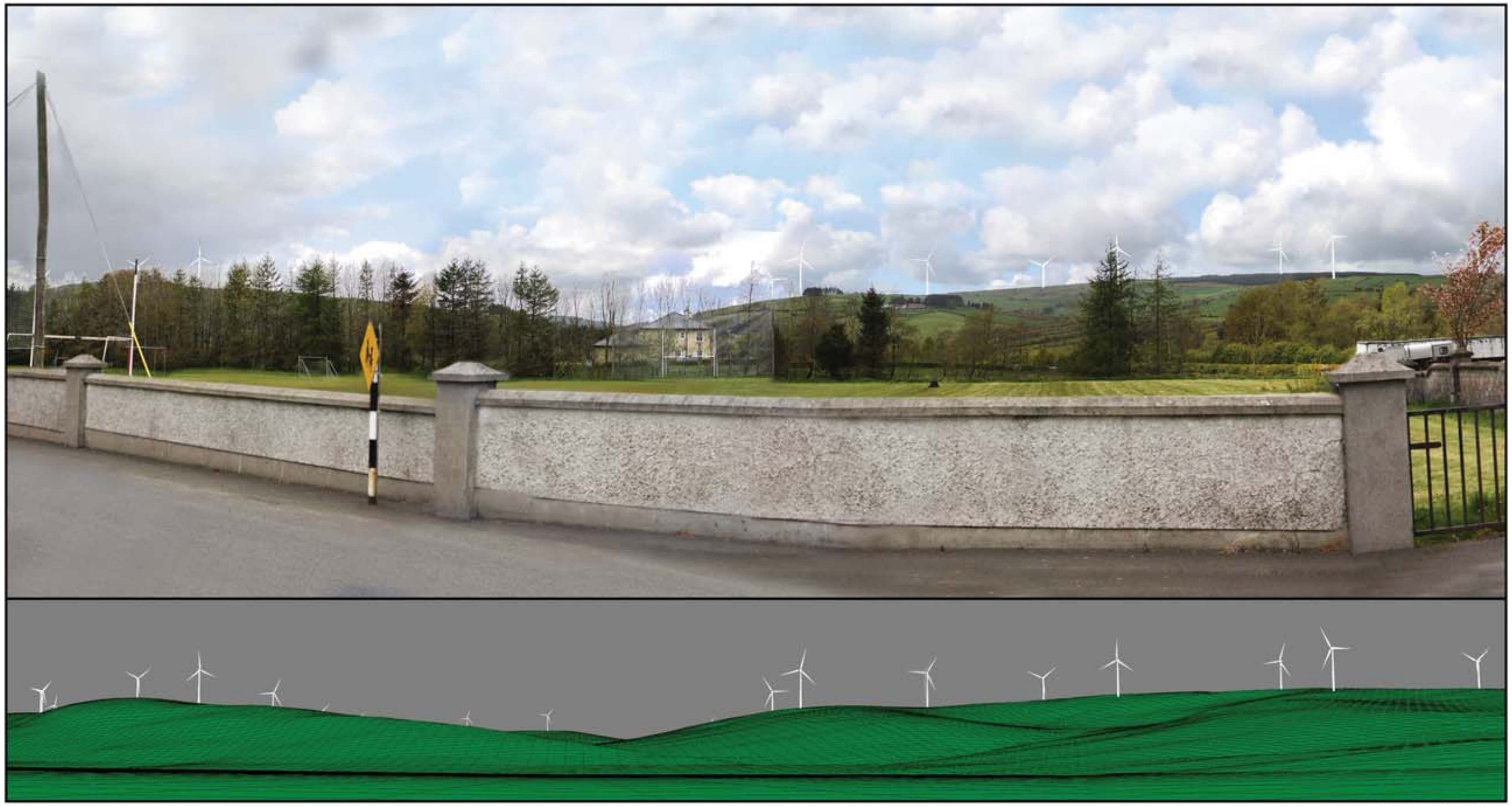
The view of the tightly clustered and overlapping turbines within the vegetated skyline is somewhat ambiguous and also generates a degree of visual clutter. These undesirable effects are moderated slightly by the low order of visual presence. On the basis of these factors the magnitude of the visual impact at CP2 is deemed to be medium.

Summary

Based on the assessment criteria and matrices outlined at section 9.3.2 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Low	medium	**Minor**

CP3: View from Upperchurch

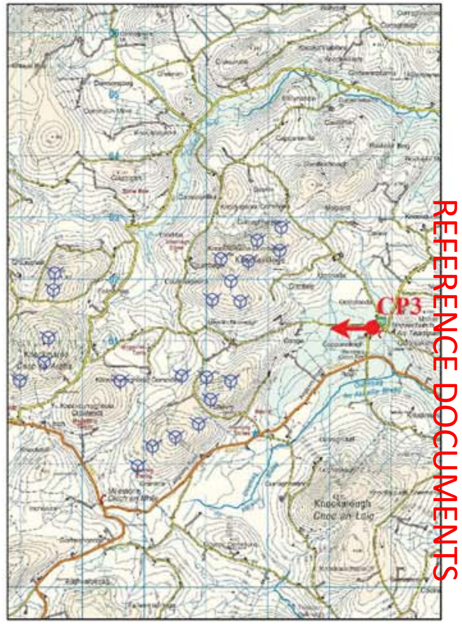


Photomontage and wireframe depiction of the proposed Upperchurch wind farm

Focal Lenght: 20mm
Recommended viewing distance: 10cm

CP3

CP3: Upperchurch	
CP3 Grid Reference:	E198670 N161178
Viewpoint elevation	190m
Nearest proposed Upperchurch turbine	1.9km
No. proposed Upperchurch turbine hubs visible	16
No. proposed Upperchurch turbine blade sets visible	19
Direction of view	W



Panned view showing the cumulative visual influence of the proposed Upperchurch turbines with the existing and permitted wind farms in the area in a landscape context

Viewshed Reference Point		Direction of View	Distance to nearest turbine:	Number of turbine hubs visible:
CP3	Upperchurch	W	1.9km	16

Representative of:

- An area identified on the ZTV map as having a theoretical view of between 19 and 22 of the proposed turbines
- The closest settlement to the proposed wind farm

Receptor Sensitivity

Low

Existing View

This is a view across a playing field from the core of Upperchurch Village. Some conifer screening at the edge of the field veils the view of the rolling hills that form a backdrop to this scene at a relatively short distance. These hills have a mixed land cover of both agriculture and silviculture. Dwellings and commercial premises can be seen to the left and right in this typical rural village street scene.

Visual Impact of Upperchurch Wind Farm

The proposed wind farm will line the ridge that contains this westerly view. The turbines are almost all fully revealed in silhouette above the skyline and the uphill view of them tends to accentuate their height. The lateral extent of the scheme is considerable when viewed from here as it occupies much of the westerly view. Even though the turbines will be a background feature of this dynamic street scene they are considered to have a dominant visual presence.

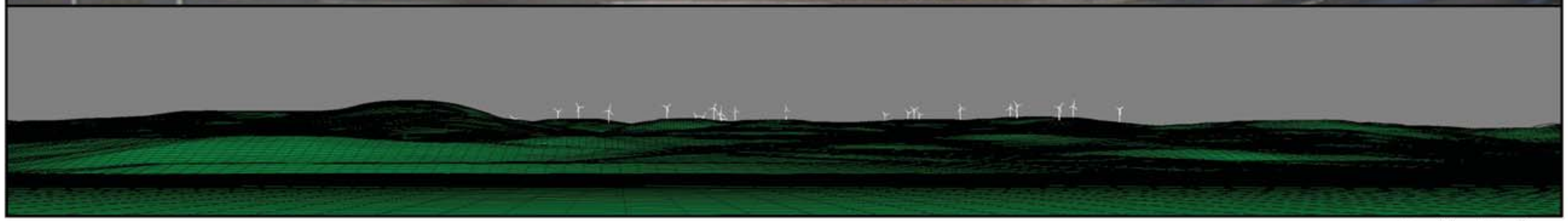
There is a relaxed linear rhythm to the spacing of the turbines and for the most part the clear view of them above the skyline makes for an unambiguous view of the scheme. However, there will be partial screening of some of the turbines by the conifers in the foreground and the blade sets will cut against the branches in perspective. This is a typical view from Upperchurch in that all of the turbines are seldom visible at once, but some will almost always be visible as part of the western backdrop of the settlement. Overall the magnitude of the visual impact is deemed to be high from Upperchurch.

Summary

Based on the assessment criteria and matrices outlined at section 9.3.2 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Low	High	**Moderate-minor**

CP4: View from Thurles



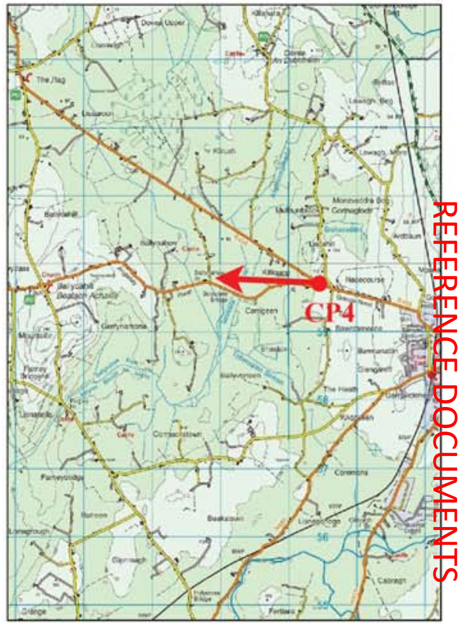
Focal lenght: 50mm
Recommended viewing distance: 39cm

Photomontage and wireframe depiction of the proposed Upperchurch wind farm

CP4

CP4: Thurles

CP4 Grid Reference:	E210471 N159701
Viewpoint elevation	107m
Nearest proposed Upperchurch turbine	13.5km
No. proposed Upperchurch turbine hubs visible	21
No. proposed Upperchurch turbine blade sets visible	22
Direction of view	W



Panned view showing the cumulative visual influence of the proposed Upperchurch turbines with the existing and permitted wind farms in the area in a landscape context

Viewshed Reference Point		Direction of View	Distance to nearest turbine:	Number of turbine hubs visible:
CP4	Thurles	W	13.5km	21

Representative of:

- An area identified on the ZTV map as having a theoretical view of between 19 and 22 of the proposed turbines
- A significant settlement
- A regional road

Receptor Sensitivity **Low**

Existing View

This is a broad and elevated view from the western outskirts of Thurles at the top of a rise. For motorists travelling west this expansive view opens abruptly from a relatively confined urban context and the viewer becomes immediately aware the landscape ahead of them. This consists of peri-urban housing in the foreground followed by gently rolling, lowland fields in the middle ground and finally the undulating backdrop of the Slieve Felim mountains. Turbines from the Glenough wind farm can be seen above the skyline ridge.

Visual Impact of Upperchurch Wind Farm

The proposed turbines will be visible at a relatively small scale, but covering a substantial section of the visible ridgeline in the centre of the panorama afforded from here. A viewer's eye is drawn through this vista towards the distinctive skyline and as such the proposed wind farm will be a noticeable feature. The turbines rise above the skyline and will be camouflaged slightly against a backdrop of sky, especially when viewed from this distance.

The turbines have an appropriate staggered linear layout and undulating profile that reflects the underlying ridge. There are only a few minor instances of turbine overlap. Whilst the proposed wind farm represents an additional, but characteristic feature in this section of the view there is a sense that wind energy development is beginning to dominate this part of the skyline. On balance of these reasons the magnitude of the visual impact at CP3 is considered to be medium.

Summary

Based on the assessment criteria and matrices outlined at section 9.3.2 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Low	Medium	**Minor**

CP5: View from Holycross

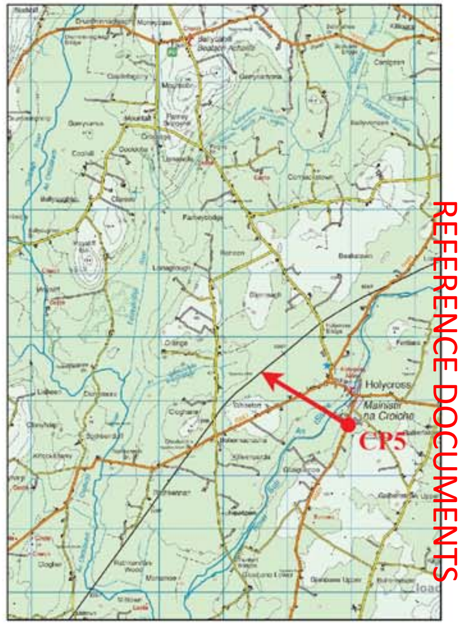
Focal lenght: 50mm
Recommended viewing distance: 39cm

Photomontage and wireframe depiction of the proposed Upperchurch wind farm

CP5

CP5: Holycross

CP5 Grid Reference:	E208937 N153643
Viewpoint elevation	94m
Nearest proposed Upperchurch turbine	14.1km
No. proposed Upperchurch turbine nacelles visible	9
No. proposed Upperchurch turbine blade sets visible	9
Direction of view	NW



Panned view showing the cumulative visual influence of the proposed Upperchurch turbines with the existing and permitted wind farms in the area in a landscape context

Viewshed Reference Point		Direction of View	Distance to nearest turbine:	Number of turbine hubs visible:
CP5	Holycross	NW	14.1km	9

Representative of:

- An area identified on the ZTV map as having a theoretical view of between 7 and 12 of the proposed turbines
- A settlement
- A regional road

Receptor Sensitivity **Low**

Existing View

This view takes in the rolling rural hinterland of Holycross, which comprises of fields and hedgerows as well as some riparian vegetation in the lower foreground associated with the River Suir. This vista is contained in the distance by the undulating profile of the Slieve Felim range. A number of turbines from the Glenough wind farm can be seen above the ridgeline.

Visual Impact of Upperchurch Wind Farm

Nine of the proposed turbines will be seen in silhouette above the skyline ridge, which tends to deemphasise them in comparison to a darker terrain backdrop. They are a fairly small scale but prominently located feature within this view. The visual presence of the development is considered to be sub-dominant from this location.

The visible turbines are relatively evenly spaced in what is an unambiguous view of the scheme. The profile of the development also matches that of the ridge below. One minor detraction, in an aesthetic sense, is the view of a single turbine from the substantially screened southerly cluster penetrating just above the skyline so that its blades will cut against the ridge in perspective. There is also a significant portion of the visible skyline now subject to wind farm development. This is ameliorated somewhat by the screening of half of the proposed scheme behind a hilltop. Overall the visual impact magnitude is deemed to be low.

Summary

Based on the assessment criteria and matrices outlined at section 9.3.2 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Low	Low	**Minor-negligible**

LC1: View from Garranakilka

Photomontage and wireframe depiction of the proposed Upperchurch wind farm

Focal Lenght: 20mm
Recommended viewing distance: 10cm

LC1

LC1: Garranakilka

LC1 Grid Reference:	E195943 N163825
Viewpoint elevation	247m
Nearest proposed Upperchurch turbine	1.5km
No. proposed Upperchurch turbine hubs visible	12
No. proposed Upperchurch turbine blade sets visible	15
Direction of view	S

Panned view showing the cumulative visual influence of the proposed Upperchurch turbines with the existing and permitted wind farms in the area in a landscape context

Viewshed Reference Point		Direction of View	Distance to nearest turbine:	Number of turbine hubs visible:
LC1	Local road at Garranakilka	S	1.5km	12

Representative of:

- An area identified on the ZTV map as having a theoretical view of between 13 and 18 of the proposed turbines
- Views from local roads and residences to the north of the site

Receptor Sensitivity **Medium**

Existing View

This is an elevated but enclosed view of the upper Clodiagh Valley. The base of the valley has a strong pastoral aesthetic comprising a pattern of fields hedgerows and occasional farmsteads. On the upper slopes and ridges that contain the view there are a number of substantial sized forest plantations. The vista has a tranquil, upland, rural character.

Visual Impact of Upperchurch Wind Farm

The proposed turbines are seen at a variety of scales due to the range in relative distances from the viewer. The nearest ones, at the left hand side of the view, are seen at a substantial scale, whilst those in the centre of the view are seen at a more modest scale. The wind farm wraps around the head of this valley and turbines will occupy the skyline ridges throughout the southerly aspect. The uphill nature of the view also tends to emphasise the height of the turbines. The visual presence of the scheme is considered to be dominant at this location.

The layout of the wind farm appears extensive, but relatively dispersed from this location. Whilst there is not a strong intensity of development in any one section of the view there is a sense of being surrounded by turbines to the south. Turbines will be a new feature of this particular vista though they could not be considered an unfamiliar feature to viewers at this locality given the surrounding developments. The sense of tranquillity and remoteness in this valley will be slightly reduced by the presence of large man-made structures, but again, wind turbines are relatively synonymous with this type of upland landscape. Overall the magnitude of the visual impact at this location is deemed to be medium.

Summary

Based on the assessment criteria and matrices outlined at section 9.3.2 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Medium	Medium	**Moderate**

LC2: View from Kilcommon Village

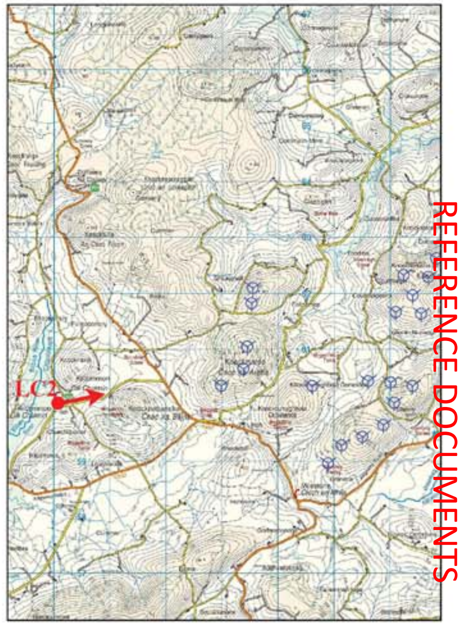
Photomontage and wireframe depiction of the proposed Upperchurch wind farm

Focal Lenght: 50mm
Recommended viewing distance: 39cm

LC2

LC2: Kilcommon Village

LC2 Grid Reference:	E190094 N160019
Viewpoint elevation	202m
Nearest proposed Upperchurch turbine	2.9km
No. proposed Upperchurch turbine hubs visible	4
No. proposed Upperchurch turbine blade sets visible	4
Direction of view	E



Panned view showing the cumulative visual influence of the proposed Upperchurch turbines with the existing and permitted wind farms in the area in a landscape context

Viewshed Reference Point		**Direction of View**	**Distance to nearest turbine:**	**Number of turbine hubs visible:**
LC2	Kilcommon Village	E	2.9km	4

Representative of:

- An area identified on the ZTV map as having a theoretical view of between 1 and 6 of the proposed turbines
- A settlement
- General views from local roads and residences a short distance to the west of the site

Receptor Sensitivity **Medium**

Existing View

This is a confined view from the centre of Kilcommon Village over the rural landscape to the west. The foreground of this vista is dominated by the settlement's church and graveyard. Beyond the edge of the settlement are steeply rolling hills cloaked in a mixture of pastoral fields and conifer plantations.

Visual Impact of Upperchurch Wind Farm

Three of the proposed turbines can be seen at a noticeable scale rising above the skyline ridges that contain this view to the east. Two of the turbines are partially obscured by buildings and by trees and headstones from the foreground graveyard and another is only visible from just below the hub behind a forested section of ridge. Because the view of the scheme is limited and it is a background element of this complex vista the visual presence is deemed to be sub-dominant.

The rural context of the turbines is clearly apparent but there are some issues of turbines overlapping within intervening landscape elements that might cause a degree of visual clutter and confusion. The approach to the church affords views over the rural countryside beyond and the turbines are not an unexpected element in this scene. Overall, the visual impact magnitude is considered to be Low at LC2.

Summary

Based on the assessment criteria and matrices outlined at section 9.3.2 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Medium	Low	**Minor**

MR1: View from Nenagh

Photomontage and wireframe depiction of the proposed Upperchurch wind farm

Focal lenght: 50mm
Recommended viewing distance: 39cm

MR1

MR1: Nenagh

MR1 Grid Reference:	E186164 N178158
Viewpoint elevation	60m
Nearest proposed Upperchurch turbine	17.7km
No. proposed Upperchurch turbine hubs visible	1
No. proposed Upperchurch turbine blade sets visible	2
Direction of view	SE

Panned view showing the cumulative visual influence of the proposed Upperchurch turbines with the existing and permitted wind farms in the area in a landscape context

Viewshed Reference Point		Direction of View	Distance to nearest turbine:	Number of turbine hubs visible:
MR1	Nenagh	SE	17.7km	1

Representative of:

- An area identified on the ZTV map as having a theoretical view of between 1 and 6 of the proposed turbines
- A significant settlement
- A regional road
- A worst case scenario view from this section of the national rail network
- Similar views from the Nenagh bypass section of theM8 motorway, which is approximately 1km closer to the site

Receptor Sensitivity **Low**

Existing View

This is a slightly elevated view to the south over the hinterland of Nenagh. The land cover in view comprises of urban fringe development intersecting with pastoral farmland. Hedgerow vegetation in the middle ground limits the view of much of the lowlands beyond, but the steeply undulating form of the Silvermines range rises to form a backdrop to the vista

Visual Impact of Upperchurch Wind Farm

Only the blades of two turbines from the proposed development can potentially be seen in the saddle between two of the distant hills. At this considerable distance they will be barely discernible even without taking into consideration the complex, fleeting and oblique view from this location. The visual presence is therefore deemed to be minimal.

The partial view of turbine blades cutting against the skyline is generally undesirable as it can lead to visual clutter and confusion. However given the low order of visual presence the magnitude of the visual impact is judged to be negligible from here.

Summary

Based on the assessment criteria and matrices outlined at section 9.3.2 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Low	Negligible	**Negligible**

MR2: View from Borrisoleigh - Templemore Road (R501)

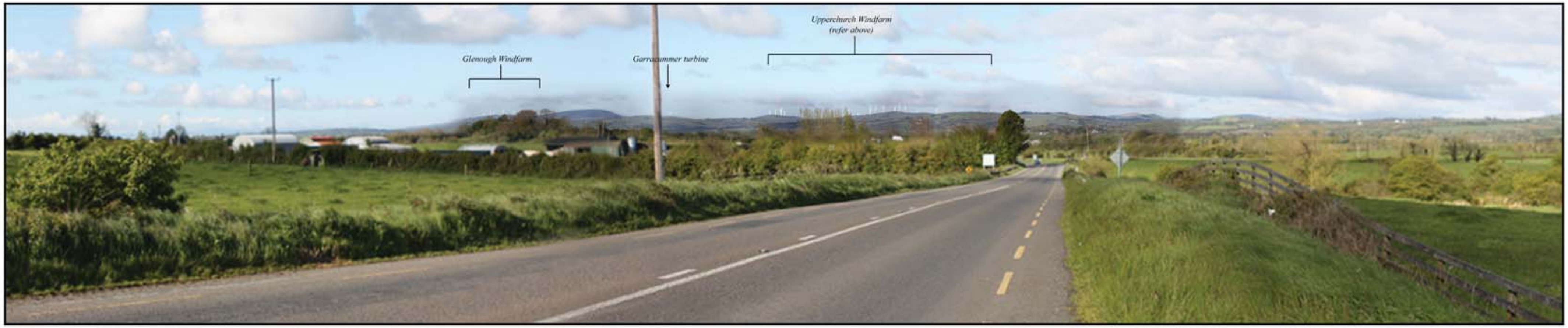
Photomontage and wireframe depiction of the proposed Upperchurch wind farm

Focal lenght: 50mm
Recommended viewing distance: 39cm

MR2

MR2: Borrisoleigh - Templemore Road (R501)

MR2 Grid Reference:	E206990 N169553
Viewpoint elevation	120m
Nearest proposed Upperchurch turbine	11.9km
No. proposed Upperchurch turbine hubs visible	21
No. proposed Upperchurch turbine blade sets visible	22
Direction of view	SW



Panned view showing the cumulative visual influence of the proposed Upperchurch turbines with the existing and permitted wind farms in the area in a landscape context

Viewshed Reference Point		Direction of View	Distance to nearest turbine:	Number of turbine hubs visible:
MR2	R501 Borrisoleigh - Templemore Road	SW	11.9km	21

Representative of:

- An area identified on the ZTV map as having a theoretical view of between 19 and 22 of the proposed turbines
- A regional road
- General views from the outer northeast of the study area

Receptor Sensitivity **Low**

Existing View

This is a broad panoramic vista from a slightly elevated location within the lowland context of the eastern study area. The view encompasses a mildly undulating rural landscape of fields and hedgerows that gives way to the steeper upland landscape of the Slieve Felim range in the distance. This comprises of a series of ridges and peaks that are stacked in perspective to form an undulating skyline.

Visual Impact of Upperchurch Wind Farm

The proposed wind farm is almost entirely visible in silhouette above the skyline ridge except for the partial screening of several turbines at the northern end of the scheme. The turbines are seen at a noticeable scale from this distance in a prominent part of the vista especially due to the almost direct alignment with the road. Although the lateral extent of the development is considerable it occupies only a small proportion of the skyline that is visible from this location. The visual presence of the wind farm is considered to be sub-dominant in this vista.

The profile of the development appropriately mimics that of the underlying ridge and despite the density of turbines in this staggered linear layout there are only a couple of minor instances of turbine overlap. Several of the blade sets will undesirably rotate against the skyline in perspective, but this will be only a minor detraction from the view of the development, which is otherwise unambiguous from here. The development represents an extension and intensification of wind energy development within this view and not a new and unfamiliar feature. Nonetheless, it increases the proportion of developed to undeveloped skyline ridge within the vista. On the basis of these reasons the visual impact magnitude is deemed to be medium at MR2.

Summary

Based on the assessment criteria and matrices outlined at section 9.3.2 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Low	Medium	**Minor**

MR3: View from Thurles - Templemore Road (N62)

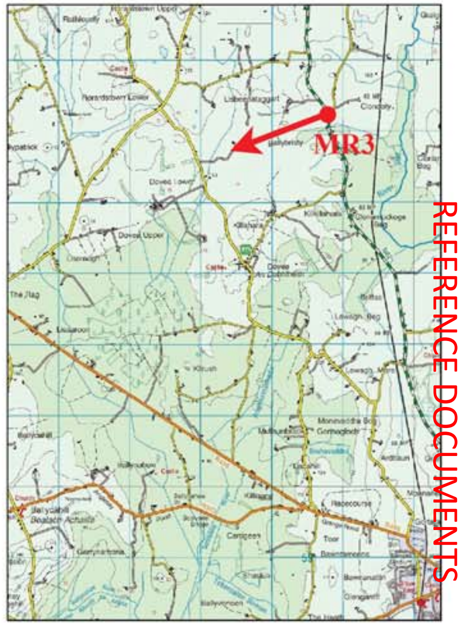
Photomontage and wireframe depiction of the proposed Upperchurch wind farm

Focal lenght: 50mm
Recommended viewing distance: 39cm

MR3

MR3: Thurles - Templemore Road (N62)

MR3 Grid Reference:	E210804 N165225
Viewpoint elevation	103m
Nearest proposed Upperchurch turbine	13.8km
No. proposed Upperchurch turbine hubs visible	17
No. proposed Upperchurch turbine blade sets visible	17
Direction of view	W



Panned view showing the cumulative visual influence of the proposed Upperchurch turbines with the existing and permitted wind farms in the area in a landscape context

Viewshed Reference Point		Direction of View	Distance to nearest turbine:	Number of turbine hubs visible:
MR3	N62 Thurles -Templemore Road	SW	13.6km	17

Representative of:

- An area identified on the ZTV map as having a theoretical view of between 19 and 22 of the proposed turbines
- A national secondary road
- General views from the outer eastern section of the study area

Receptor Sensitivity **Low**

Existing View

This is a broad horizontal vista from within the lowland context of the eastern study area. A view of some sections of the Slieve Felim ridgeline can be seen just above foreground hedgerows that define a large grassed field. This is a fairly typical rural view over a gently undulating, productive landscape.

Visual Impact of Upperchurch Wind Farm

The proposed wind farm can be seen at a fairly small scale at this distance rising above the distant skyline. Approximately one third of the turbines at the northern end and one third at the southern end of the scheme are visible, whilst those at the centre are screened from view by intervening vegetation. The turbines are oblique to the road and may not be noticed by the casual observer passing along this route. The visual presence of the development is in the order of minimal to sub-dominant.

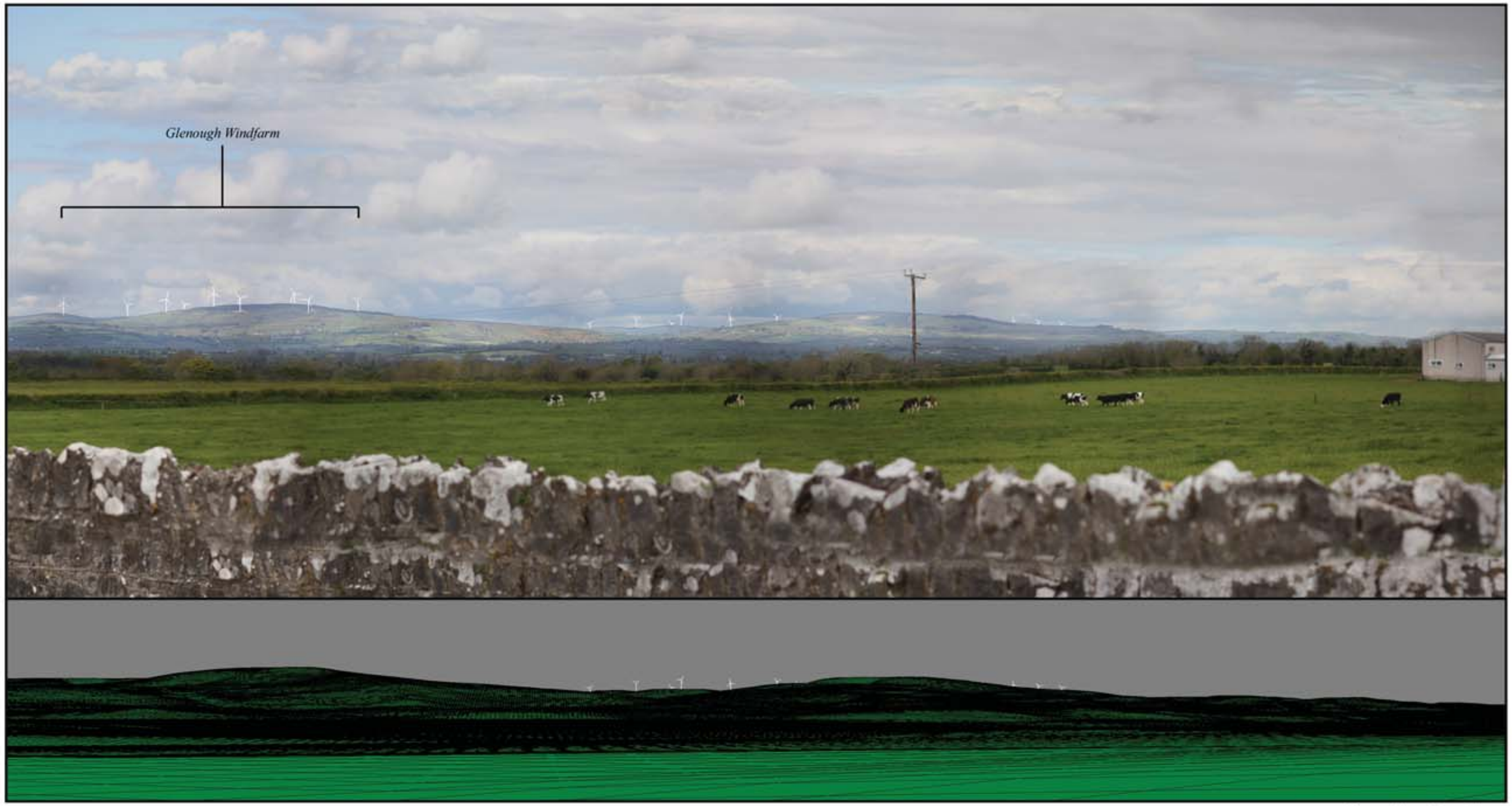
The proposed turbines are seen in a staggered linear arrangement that rises and falls in accordance with the ridgeline. There will be a minor visual distraction caused by several blade sets rotating within the middle ground tree line but this is likely to be barely noticeable giving the distances involved and the fleeting nature of the view. Overall the visual impact magnitude is deemed to be low from here.

Summary

Based on the assessment criteria and matrices outlined at section 9.3.2 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Low	Low	**Minor-negligible**

MR4: View from Boherlahan (R660)



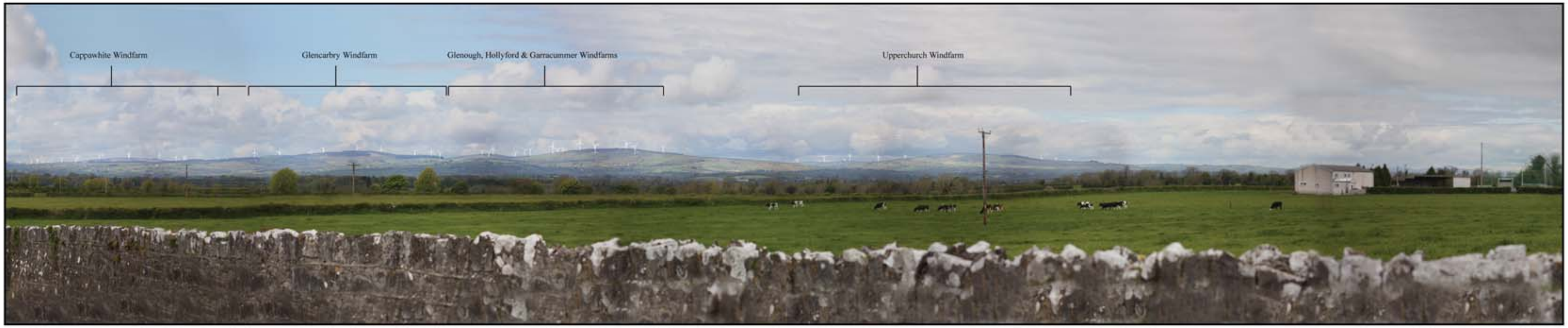
Photomontage and wireframe depiction of the proposed Upperchurch wind farm

Focal lenght: 50mm
Recommended viewing distance: 39cm

MR4

MR4: Boherlahan (R660)

MR4 Grid Reference:	E207191 N146050
Viewpoint elevation	94m
Nearest proposed Upperchurch turbine	17.7km
No. proposed Upperchurch turbine hubs visible	9
No. proposed Upperchurch turbine blade sets visible	9
Direction of view	NW



Panned view showing the cumulative visual influence of the proposed Upperchurch turbines with the existing and permitted wind farms in the area in a landscape context

Viewshed Reference Point		Direction of View	Distance to nearest turbine:	Number of turbine hubs visible:
MR4	R660 at Boherlahan	NW	17.7km	9

Representative of:

- An area identified on the ZTV map as having a theoretical view of between 7 and 12 of the proposed turbines
- A regional road
- A small settlement

Receptor Sensitivity **Low**

Existing View This is a westerly view towards the Slieve Felim Mountains from the small settlement of Boherlahan that lines the R660. The intervening landscape is predominantly rural comprising of gently rolling fields and hedgerows, but with some buildings associated with the settlement visible to the right-hand side in the foreground. The turbines of the Glenough Wind Farm can be seen above the undulating skyline ridge.

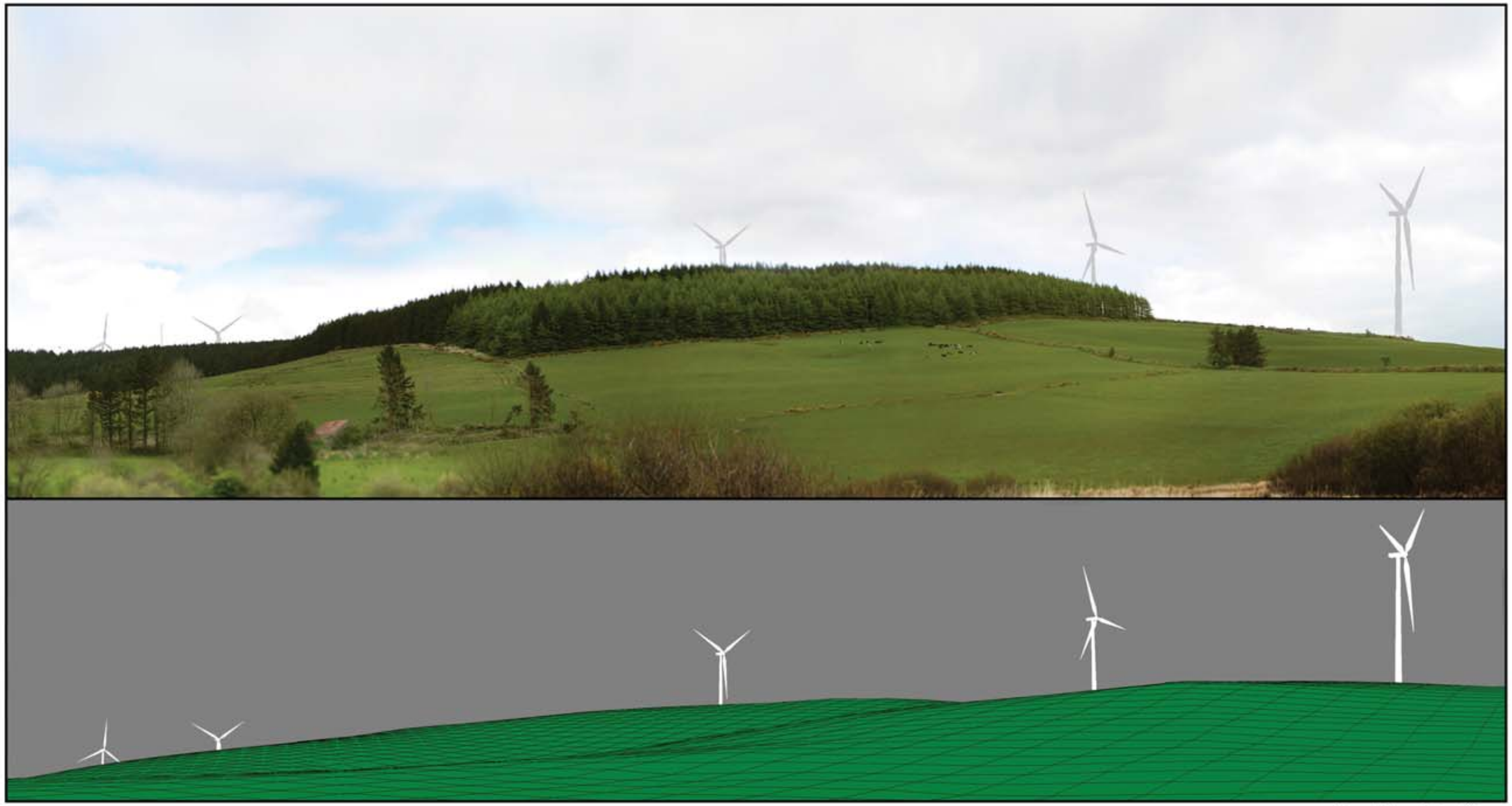
Visual Impact of Upperchurch Wind Farm The proposed wind farm is partly screened from view by a peak in the skyline ridge so that 6 turbines are almost fully revealed to the left hand side of it with only 3 blade sets seen to the right. The turbines are seen at a noticeable scale from this distance although they are less prominent than the adjacent Glenough turbines. Whilst the proposed turbines are likely to have a sub-dominant visual presence in their own right, when viewed in conjunction with the Glenough turbines the collective developments are considered to be co-dominant.

The 6 turbines at the southern end of the scheme have a fairly even spacing with only one instance of a turbine cutting against the skyline ridge, whereas all three of the visible turbines at the northern end of the scheme will generate this effect. Due to the screening of the central turbines by the intervening hilltop, the two clusters may be perceived as separate developments. Any visual confusion caused by this relationship is balanced by the fact that the prominent section of the ridgeline remains undeveloped. This is an important consideration in this instance as the proportion of developed to undeveloped skyline in this section of the view will be fairly even as a result of the proposal. On the basis of these reasons the magnitude of the visual impact is considered to be medium.

Summary Based on the assessment criteria and matrices outlined at section 9.3.2 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Low	Medium	**Minor**

DR1: View from the Dolla Road (R497)



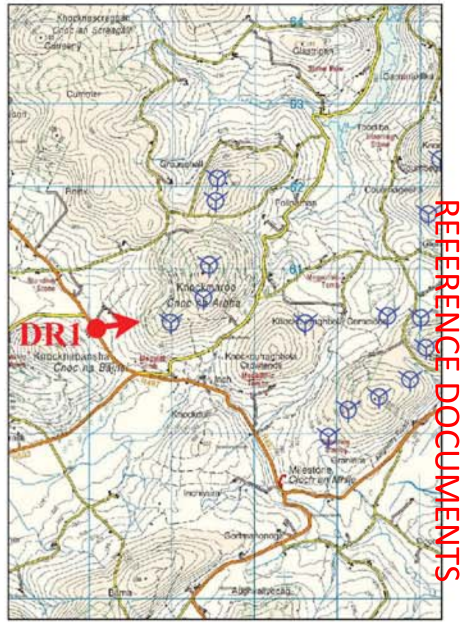
Photomontage and wireframe depiction of the proposed Upperchurch wind farm

Focal lenght: 40mm
Recommended viewing distance: 21cm

DR1

DR1: Dolla Road (R497)

DR1 Grid Reference:	E192092 N160232
Viewpoint elevation	240m
Nearest proposed Upperchurch turbine	0.9km
No. proposed Upperchurch turbine hubs visible	5
No. proposed Upperchurch turbine blade sets visible	5
Direction of view	E



Panned view showing the cumulative visual influence of the proposed Upperchurch turbines with the existing and permitted wind farms in the area in a landscape context

Viewshed Reference Point		Direction of View	Distance to nearest turbine:	Number of turbine hubs visible:
DR1	Dolla Road (R497) near Anglesey Road Junction	E	0.9	5

Representative of:

- An area identified on the ZTV map as having a theoretical view of between 1 and 6 of the proposed turbines
- A designated scenic route
- A regional road

Receptor Sensitivity **Medium**

Existing View

This is a short distance uphill view over a relatively steep slope comprising of marshland at the base, pastoral farmland on the mid-slope and a forested crest. There is a thick band of marshy scrub adjacent to the road, which limits extended views from much of this section of the route.

Visual Impact of Upperchurch Wind Farm

Several of the proposed turbines rise just above the near, forested ridgeline, but due to the close proximity and the uphill nature of the view they are seen at a substantial scale. The most that can be seen of any of the turbines is a full blade set and this occurs in only one instance. For the remaining visible turbines only the hubs and blades can be seen. Given the close proximity, the proposal is considered to have a co-dominant visual presence from here.

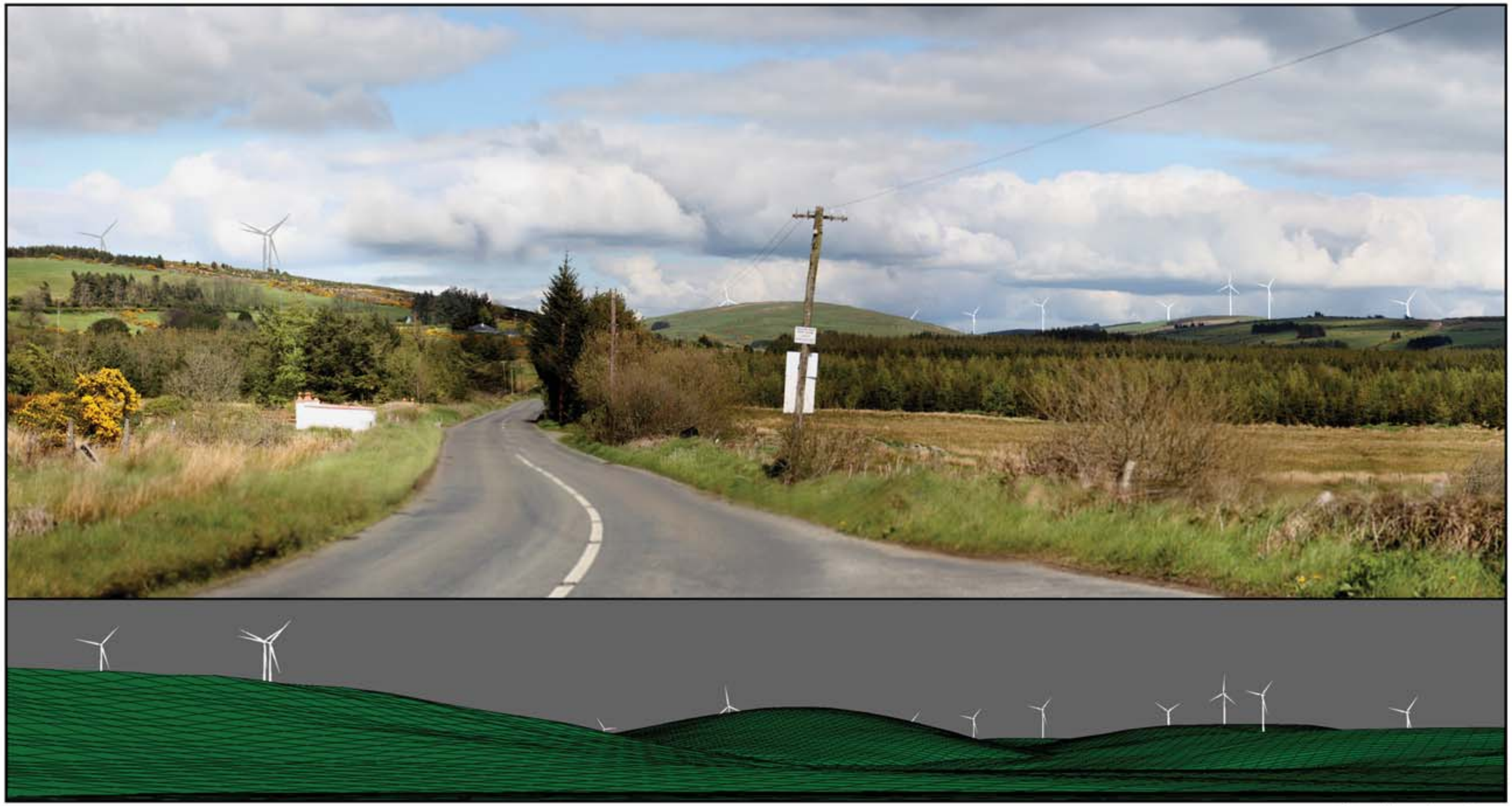
Aesthetically speaking this is not an ideal viewing scenario, with partial views of turbines cutting against a near skyline ridge. This can cause a degree of visual clutter and confusion as well as generating eye catching motion. These effects are moderated somewhat by the limited view of only a small proportion of the proposed turbines. This is also an anthropogenic vista in an area where turbines are a familiar feature. On balance the magnitude of the visual impact is deemed to be medium.

Summary

Based on the assessment criteria and matrices outlined at section 9.3.2 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Medium	Medium	**Moderate**

DR2: View from Anglesey Road at Loughbrack



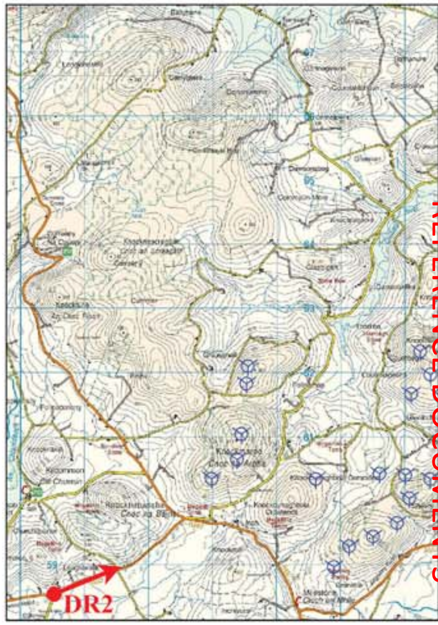
Photomontage and wireframe depiction of the proposed Upperchurch wind farm

Focal Lenght: 50mm
Recommended viewing distance: 39cm

DR2

DR2: Anglesey Road at Loughbrack

DR2 Grid Reference:	E190521 N158532
Viewpoint elevation	220m
Nearest proposed Upperchurch turbine	3.0km
No. proposed Upperchurch turbine hubs visible	11
No. proposed Upperchurch turbine blade sets visible	12
Direction of view	NE



Panned view showing the cumulative visual influence of the proposed Upperchurch turbines with the existing and permitted wind farms in the area in a landscape context

Viewshed Reference Point		Direction of View	Distance to nearest turbine:	Number of turbine hubs visible:
DR2	Anglesey Road at Loughbrack	NE	3km	11

Representative of:

- An area identified on the ZTV map as having a theoretical view of between 13 and 18 of the proposed turbines
- A designated scenic route
- Views from local roads and residences

Receptor Sensitivity **Medium**

Existing View

This is a northerly view from within the upland context of the study area. The terrain in the foreground is flat and boggy and has a land cover of rough pasture and scrub as well as extensive conifer plantations. Better quality pasture occurs on the series of rolling hills that contain the vista at a relatively short distance.

Visual Impact of Upperchurch Wind Farm

Approximately half of the proposed turbines will rise above three different hills that make up the skyline to the northeast. The nearest and largest scale turbines can be seen in a cluster of three to the left of the road alignment. The remaining turbines are seen at a slightly more modest scale. The scheme occupies a wide portion of the northerly vista and it is considered to have a dominant visual presence.

Aside from one instance of turbine overlap and a couple of blades cutting against the skyline, the scheme is unambiguously displayed from here. The extensive nature of the scheme within the view is balanced by its dispersal and, therefore, a low degree of intensity. Nonetheless there is some sense of being surrounded by turbines, at least in this northern aspect. On the basis of these reasons the magnitude of the visual impact id deemed to be medium.

Summary

Based on the assessment criteria and matrices outlined at section 9.3.2 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Medium	Medium	**Moderate**

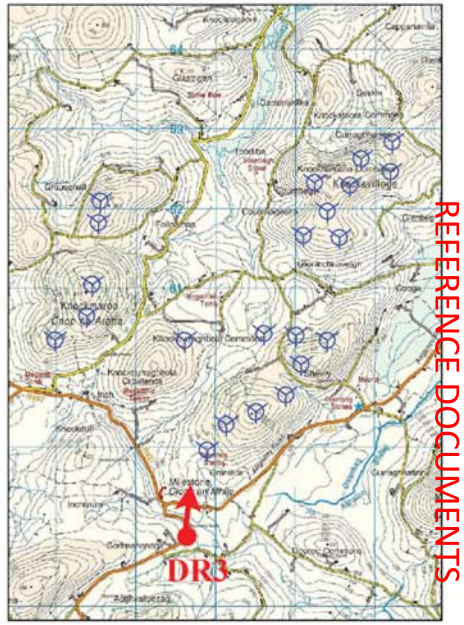
DR3: View from Anglesey Road near Milestone

Photomontage and wireframe depiction of the proposed Upperchurch wind farm

DR3

DR3: Anglesey Road near Milestone

DR3 Grid Reference:	E194669 N157872
Viewpoint elevation	250m
Nearest proposed Upperchurch turbine	1.1km
No. proposed Upperchurch turbine hubs visible	9
No. proposed Upperchurch turbine blade sets visible	10
Direction of view	N



Panned view showing the cumulative visual influence of the proposed Upperchurch turbines with the existing and permitted wind farms in the area in a landscape context

Viewshed Reference Point		Direction of View	Distance to nearest turbine:	Number of turbine hubs visible:
DR3	Anglesey Road at Milestone	N	1.1km	9

Representative of:

- An area identified on the ZTV map as having a theoretical view of between 7 and 12 of the proposed turbines
- A designated scenic route
- A regional road
- Views from local residences

Receptor Sensitivity **Medium**

Existing View This is a relatively contained vista over the rolling landscape at the centre of the study area. In the lower foreground, the flat base of the valley is in rough pasture reflecting the boggy nature of the soil. On the more free draining slopes above are large pastoral fields divided by scrubby hedgerows.

Visual Impact of Upperchurch Wind Farm Only five of the proposed turbines can be seen clearly from here rising above the undulating ridgeline, whilst several others are substantially screened by the ridge or intervening vegetation. The nearest turbines, which are almost fully revealed, are seen at a significant scale, but there is a considerable scale differential to those that are seen further in the distance. The turbines will be the most noticeable singular element in this vista and as such they are considered to have a dominant visual presence.

The scale differential between the nearest and furthest of the turbines creates a striking sense of perspective that contributes to the picturesque qualities of this vista. It also reveals the extensive nature of this scheme, but as with other close views, this is countered by the limited number of visible turbines and the apparent low intensity of the development. There are a couple of instances of turbines blades cutting against the ridgeline and foreground vegetation. However, these are fairly minor issues in the context of what is otherwise an uncomplicated view of the scheme. Overall the magnitude of the visual impact is considered to be medium.

Summary Based on the assessment criteria and matrices outlined at section 9.3.2 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Medium	Medium	**Moderate**

DR4: View from the Anglesey Road at Ruan

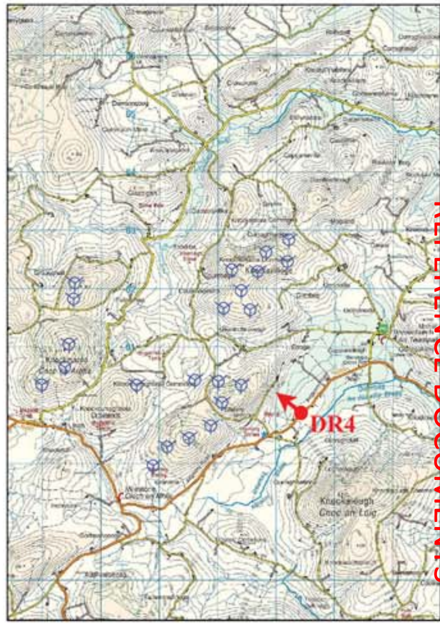
Photomontage and wireframe depiction of the proposed Upperchurch wind farm

Focal lenght: 15mm
Recommended viewing distance: 8cm

DR4

DR4: Anglesey Road at Ruan

DR4 Grid Reference:	E197436 N159843
Viewpoint elevation	206m
Nearest proposed Upperchurch turbine	1.1km
No. proposed Upperchurch turbine hubs visible	12
No. proposed Upperchurch turbine blade sets visible	13
Direction of view	W - NW



Panned view showing the cumulative visual influence of the proposed Upperchurch turbines with the existing and permitted wind farms in the area in a landscape context

Viewshed Reference Point		Direction of View	Distance to nearest turbine:	Number of turbine hubs visible:
DR4	Anglesey Road at Ruan	NW	1.1km	12

Representative of:

- An area identified on the ZTV map as having a theoretical view of between 13 and 18 of the proposed turbines
- A designated scenic route
- A regional road
- Views from local residences

Receptor Sensitivity **Medium**

Existing View

This is a somewhat confined view from within the rolling upland context of the central study area. The foreground roadside context of a dwelling and nearby hedgerow limits the view over the landscape beyond until a steep ridge emerges to contain the vista at a modest distance. The slopes below the ridge are clad in pastoral fields and sporadic hedgerows as well as small stands of conifers and patches of scrubby vegetation.

Visual Impact of Upperchurch Wind Farm

Five of the proposed turbines from the southern cluster of the scheme can be seen rising at a prominent scale above the near ridgeline at the left hand side of the view. A similar number from the northern cluster can be seen at a slightly greater distance to the right hand side of the view. The scheme would be immediately noticeable from this section of the road and it is likely to have a dominant visual presence in the context of this relatively confined vista.

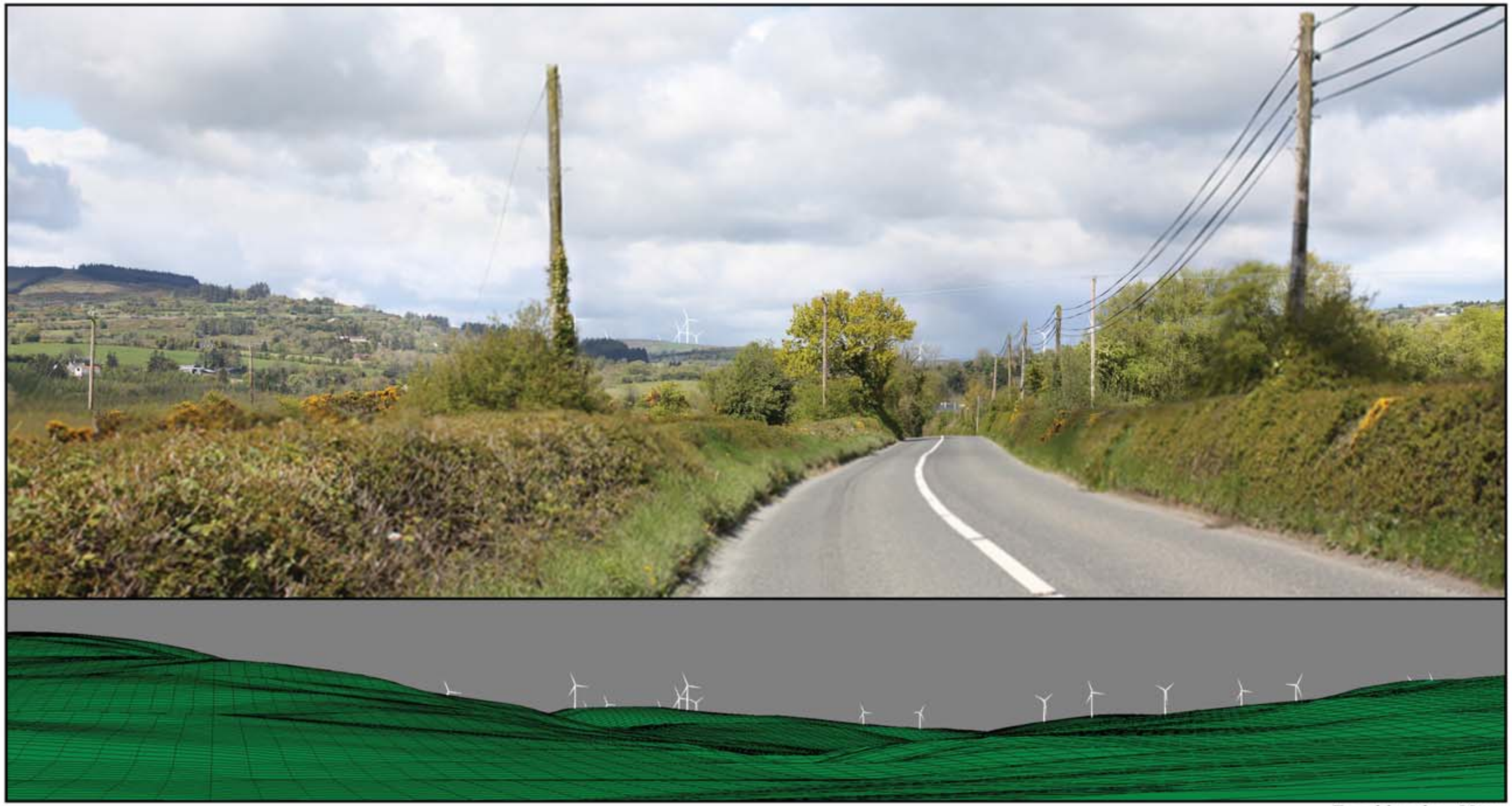
The scheme is perceived to have a fairly modest extent from here due to the view of only a limited number of turbines. These are seen in a simple arrangement above the crown of the hill, but with some turbines overlapping or blades sets cutting against the skyline in perspective. The character of this vista is strongly anthropogenic and turbines are a familiar element in the local area. For these reasons the magnitude of the visual impact is judged to me medium.

Summary

Based on the assessment criteria and matrices outlined at section 9.3.2 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Medium	Medium	**Moderate**

DR5: View from the Anglesey Road at Rossoulty



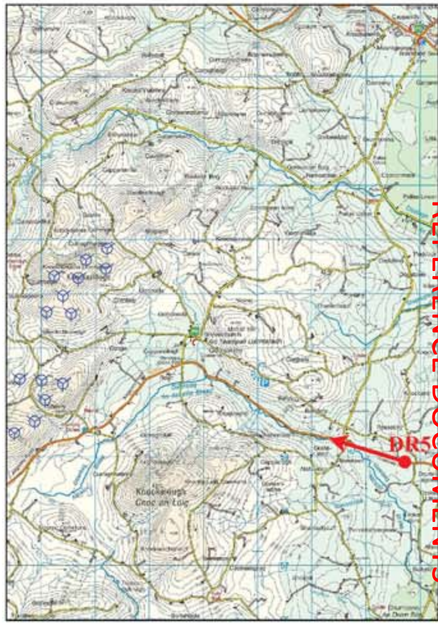
Photomontage and wireframe depiction of the proposed Upperchurch wind farm

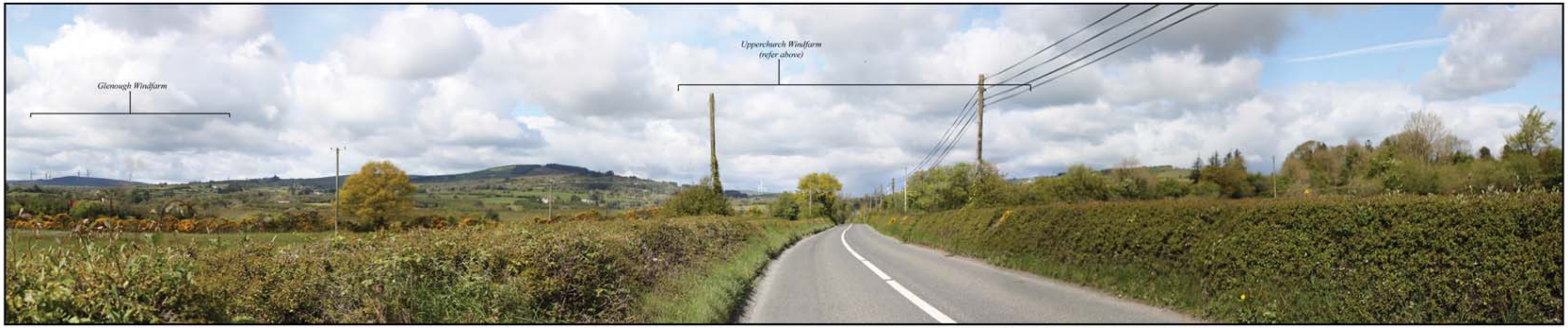
Focal lenght: 50mm
Recommended viewing distance: 39cm

DR5

DR5: Anglesey Road at Rossoulty

DR5 Grid Reference:	E202740 N158906
Viewpoint elevation	141m
Nearest proposed Upperchurch turbine	6.5km
No. proposed Upperchurch turbine hubs visible	13
No. proposed Upperchurch turbine blade sets visible	17
Direction of view	W





Panned view showing the cumulative visual influence of the proposed Upperchurch turbines with the existing and permitted wind farms in the area in a landscape context

Viewshed Reference Point		Direction of View	Distance to nearest turbine:	Number of turbine hubs visible:
DR5	Anglesey Road at Rossoulty	W	6.5km	13

Representative of:

- An area identified on the ZTV map as having a theoretical view of between 13 and 18 of the proposed turbines
- A designated scenic route
- A regional road

Receptor Sensitivity **Medium**

Existing View

This is a relatively broad vista, particularly to the south, from the R503 as it enters the foothills of the Slieve Felim range. The slopes of these hills are cloaked in a combination of fields and hedgerows, patches of broadleaf woodland and blocks of commercial conifer forest at higher levels. The Glenough Wind farm can be clearly seen further along the ridge to the south.

Visual Impact of Upperchurch Wind Farm

Only three of the proposed turbines are clearly visible from this point rising above the skyline ridge in a tight cluster just to the left hand side of the road alignment. A number of other turbines can also be seen with closer scrutiny to the left and right of the road, but these are substantially screened by the ridge and/or foreground vegetation. The visual presence of the scheme is considered to be in the order of sub-dominant to co-dominant.

This is not an optimal view of the scheme in anaesthetic sense as there is a reasonable level of visual ambiguity generated. This relates to the partial view of the scheme with turbines cutting against intervening landscape elements or overlapping each other. In the context of the anthropogenic landscape character and the presence of other turbines within the view, there is little change to the nature of the vista. For these reasons the magnitude of the visual impact is deemed to be medium at DR5.

Summary

Based on the assessment criteria and matrices outlined at section 9.3.2 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Medium	Medium	**Moderate**

DR6: View from the The Ragg/Inch on the R498 Borrisoleigh Road

Photomontage and wireframe depiction of the proposed Upperchurch wind farm

Focal lenght: 50mm
Recommended viewing distance: 39cm

DR6

DR6: The Ragg/Inch (R498)

DR6 Grid Reference:	E205586 N164444
Viewpoint elevation	90m
Nearest proposed Upperchurch turbine	8.5km
No. proposed Upperchurch turbine hubs visible	13
No. proposed Upperchurch turbine blade sets visible	15
Direction of view	SW

REFERENCE DOCUMENTS

Panned view showing the cumulative visual influence of the proposed Upperchurch turbines with the existing and permitted wind farms in the area in a landscape context

Viewshed Reference Point		**Direction of View**	**Distance to nearest turbine:**	**Number of turbine hubs visible:**
DR6	R492 at The Ragg/Inch	SW	8.5	13

Representative of:

- An area identified on the ZTV map as having a theoretical view of between 13 and 18 of the proposed turbines
- A designated scenic route
- A regional road

Receptor Sensitivity **Medium**

Existing View

This is a westerly vista towards the Slieve Felim range from within the rural lowland context in the eastern portion of the study area. The landscape in view comprises of flat to gently rolling farmland in the foreground surrounding several dwellings. Above the tops of the foreground vegetation rises the Slieve Felim foothills and these have a clearly defined, pastoral field pattern with conifer forests at upper levels. Several turbines from the Glenough Wind Farm can be seen above the ridge to the south.

Visual Impact of Upperchurch Wind Farm

The proposed turbines are seen at a noticeable scale from this distance although only those at the northern end of the scheme rise fully above the skyline ridge. Only blade sets and blade tips of several of the turbines that comprise the southern cluster penetrate above the ridge. The visual presence of the scheme is deemed to be sub-dominant within the context of this vista.

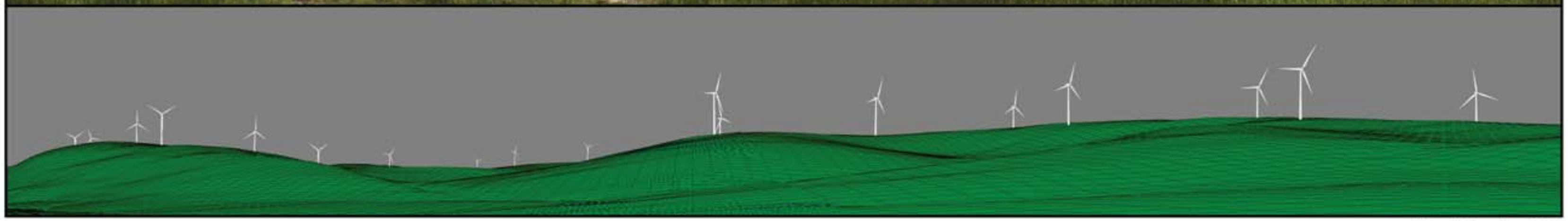
The turbines from the northern cluster of the scheme are well revealed with a staggered linear layout that avoids instances of overlapping and with a collective profile that compliments the underlying terrain. The partial view of the southern cluster of turbines is less satisfactory in an aesthetic sense with blade sets cutting against the skyline ridge in perspective. However, this cluster is far less noticeable than the northern cluster. The proposed turbines are a familiar element within this anthropogenic vista and for these reasons the magnitude of the visual impact is judged to be low.

Summary

Based on the assessment criteria and matrices outlined at section 9.3.2 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Medium	low	**Minor**

AV1: View from Slí Éamoin an Chnoic



Focal lenght: 20mm
Recommended viewing distance: 10cm

Photomontage and wireframe depiction of the proposed Upperchurch wind farm

AV1

AV1: Slí Éamoin an Chnoic

AV1 Grid Reference:	E198380 N161584
Viewpoint elevation	200m
Nearest proposed Upperchurch turbine	1.5km
No. proposed Upperchurch turbine hubs visible	18
No. proposed Upperchurch turbine blade sets visible	18
Direction of view	W

Panned view showing the cumulative visual influence of the proposed Upperchurch turbines with the existing and permitted wind farms in the area in a landscape context

Viewshed Reference Point		**Direction of View**	**Distance to nearest turbine:**	**Number of turbine hubs visible:**
AV1	Slí Éamoin an Cnoic	W	1.5km	18

Representative of:

- An area identified on the ZTV map as having a theoretical view of between 13 and 18 of the proposed turbines
- A signposted local loop walk – part of the national looped walk network
- Views from local residences

Receptor Sensitivity **Medium**

Existing View

This is an enclosed vista to the west from a point on the Slí Éamoin an Cnoic. The rolling upland landscape in view has a rich and varied land cover ranging from a flat marshy field in the foreground to pastoral fields and hedgerows on sloping ground and conifer plantations on some hilltops. The vista has a remote rural character.

Visual Impact of Upperchurch Wind Farm

The proposed turbines are seen at a significant scale from this short viewing distance and the uphill nature of the view accentuates their height. The lateral extent of the scheme is also considerable within this relatively contained vista. For these reasons the scheme is considered to have a dominant visual presence at this location.

The turbines have a clear and simple arrangement when viewed from here. The majority are fully revealed above the skyline ridge in a legible linear rhythm and the profile of the scheme compliments that of the ridgeline. There is also a picturesque sense of perspective generated in the varying scale between the nearest and furthest turbines. The extent of the scheme is somewhat dominant in relation to the contained vista and the finer grain of the land use patterns below. On balance of these reasons the magnitude of the visual impact is deemed to be high.

Summary

Based on the assessment criteria and matrices outlined at section 9.3.2 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Medium	High	**Major-moderate**

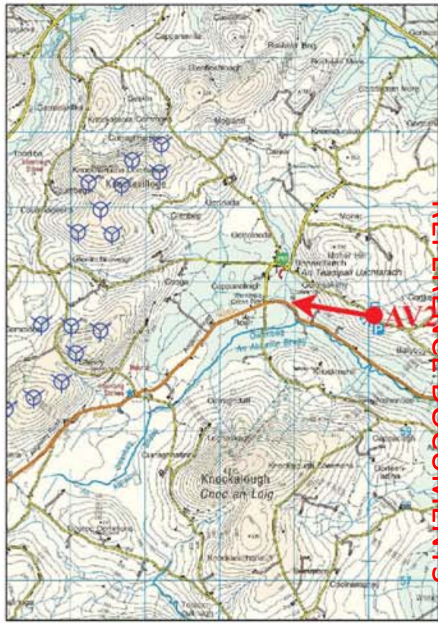
AV2: View from Ballyboy Lookout

Photomontage and wireframe depiction of the proposed Upperchurch wind farm

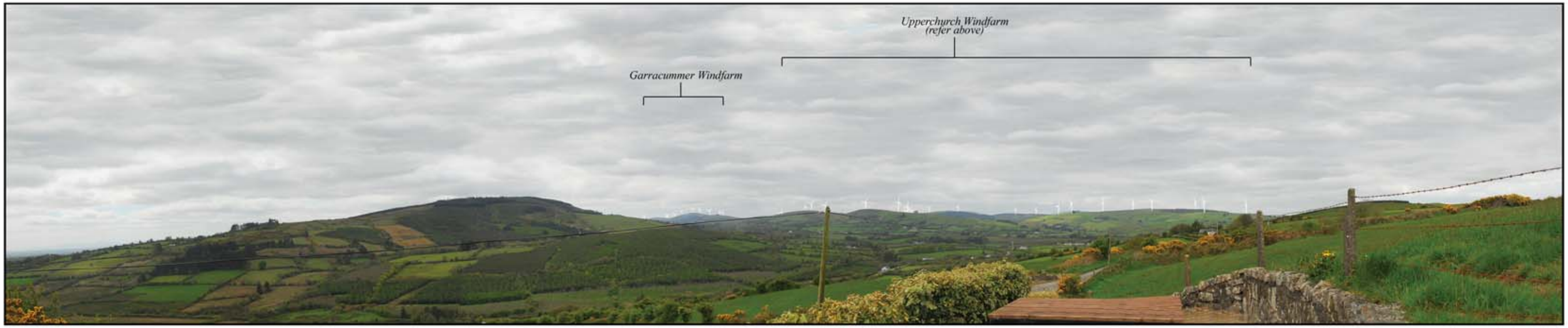
Focal Lenght: 35mm
Recommended viewing distance: 18cm

AV2

AV2: Ballyboy Lookout	
AV2 Grid Reference:	E200070 N160488
Viewpoint elevation	261m
Nearest proposed Upperchurch turbine	3.5km
No. proposed Upperchurch turbine hubs visible	22
No. proposed Upperchurch turbine blade sets visible	22
Direction of view	W



REFERENCE DOCUMENTS



Panned view showing the cumulative visual influence of the proposed Upperchurch turbines with the existing and permitted wind farms in the area in a landscape context

Viewshed Reference Point		Direction of View	Distance to nearest turbine:	Number of turbine hubs visible:
AV2	Ballyboy lookout point	W	3.5km	22

Representative of:

- An area identified on the ZTV map as having a theoretical view of between 19 and 22 of the proposed turbines
- A locally recognised and signposted lookout point

Receptor Sensitivity **High**

Existing View This is a broadly panoramic and highly elevated lookout point that affords views over the upland context of the Slieve Felim range to the west and the lowland plains to the east. Almost the entire landscape in view is in productive use as either agriculture or silviculture. Even so, there is a reasonable level of complexity within the view and this lookout provides an idyllic and tranquil location to take it in.

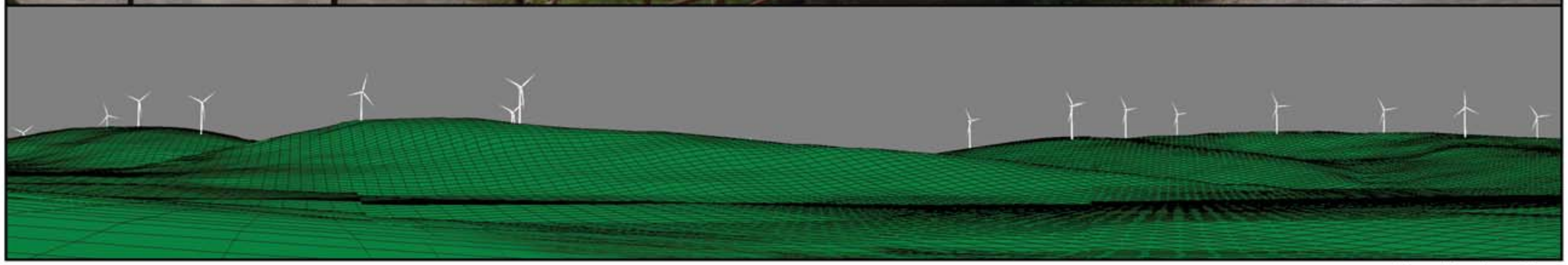
Visual Impact of Upperchurch Wind Farm A view of all of the proposed turbines is afforded from this elevated viewpoint and the scheme occupies a significant section of the view to the west. However, in the context of the full panorama this is a fairly small proportion of the vista. The turbines are seen at a reasonable scale from this distance, but it is the extent of the scheme that draws attention. In the context of this vista the proposed wind farm is deemed to be co-dominant in terms of visual presence.

Aesthetically speaking the turbines are well displayed from here in an uncomplicated manner. Nearly all of the turbines are fully visible in silhouette above the skyline with a staggered linear layout that accords with both the terrain and land cover patterns in the vicinity. There is, however, a noticeable contrast in scale between the overall extent of the scheme and the more intricate nature of the surrounding land cover pattern. This gives a minor sense of visual ambivalence. Turbines are a characteristic feature of this general area and the only effect on the character of the view is an increased intensity of built development. On the basis of these reasons the proposed wind farm is considered to generate a medium visual impact magnitude.

Summary Based on the assessment criteria and matrices outlined at section 9.3.2 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
High	Medium	**Major-moderate**

AV3: View from Knockalough Looped Walk



Focal lenght: 25mm
Recommended viewing distance: 13cm

Photomontage and wireframe depiction of the proposed Upperchurch wind farm

AV3

AV3: Knockalough Looped Walk

AV3 Grid Reference:	E198689 N159873
Viewpoint elevation	214m
Nearest proposed Upperchurch turbine	2.3km
No. proposed Upperchurch turbine hubs visible	14
No. proposed Upperchurch turbine blade sets visible	15
Direction of view	NW

Panned view showing the cumulative visual influence of the proposed Upperchurch turbines with the existing and permitted wind farms in the area in a landscape context

Viewshed Reference Point		Direction of View	Distance to nearest turbine:	Number of turbine hubs visible:
AV3	Knockalough looped walk	NW	2.3km	14

Representative of:

- An area identified on the ZTV map as having a theoretical view of between 13 and 18 of the proposed turbines
- A signposted local loop walk – part of the national looped walk network
- Views from local roads and residences

Receptor Sensitivity **Medium**

Existing View

This is a panoramic vista to the northwest from an elevated local road. The view afforded crosses an upland valley and is contained at a modest distance by the opposing ridgeline. The land cover in the valley consists of a combination of grazing land and conifer plantations with some small patches of broadleaf woodland.

Visual Impact of Upperchurch Wind Farm

The proposed wind farm will occupy the majority of the ridgeline on the opposite side of the valley and at this short distance the visible turbines are seen at a considerable scale. The turbines will be the most prominent singular feature in the view and thus, their visual presence is deemed to be dominant.

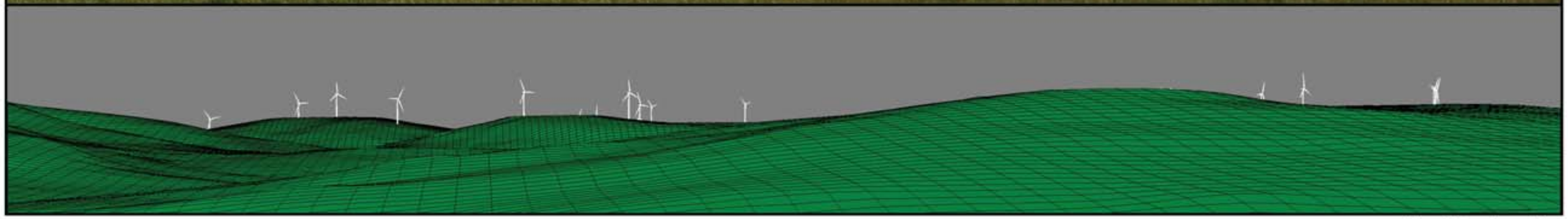
The line of turbines that tops the ridge is evenly and generously spaced and the profile of the scheme undulates in accordance with the terrain. This is diluted slightly by a more ambiguous and distracting view of the more distant turbines cutting against the skyline ridge in perspective. The considerable extent of the scheme is also considered to be somewhat dominant in the context of this vista. The character of this anthropogenic rural vista is not unduly influenced by the presence of wind turbines, which are relatively synonymous with this type of upland landscape, particularly in the vicinity. Overall, the magnitude of the visual impact is judged to be medium.

Summary

Based on the assessment criteria and matrices outlined at section 9.3.2 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Medium	Medium	**Moderate**

AV4: View from Birch Hill Looped Walk



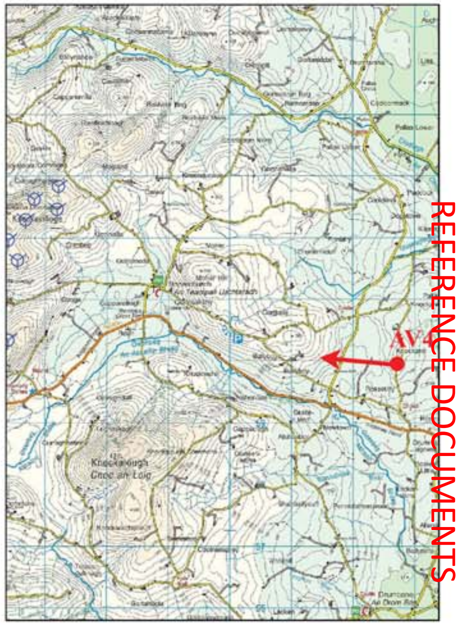
Photomontage and wireframe depiction of the proposed Upperchurch wind farm

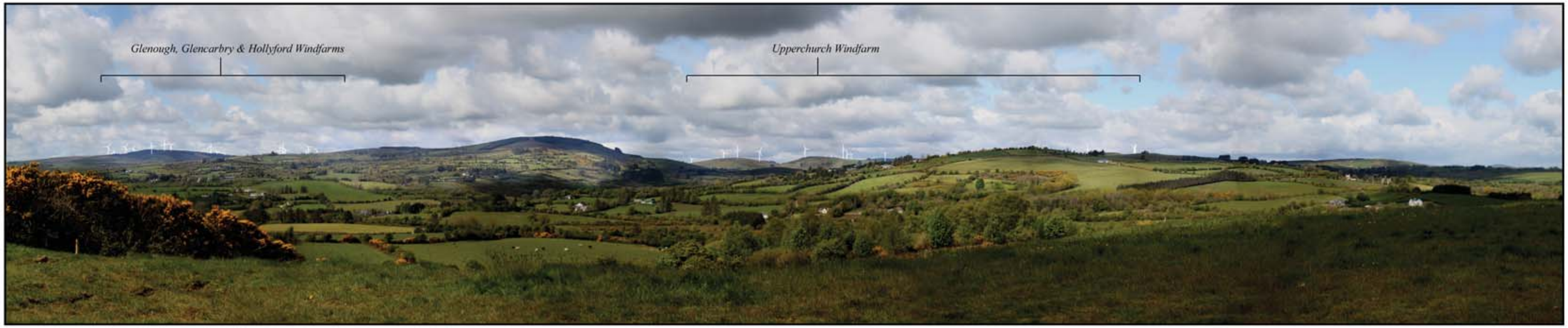
Focal Lenght: 50mm
Recommended viewing distance: 39cm

AV4

AV4: Birch Hill Looped Walk

AV4 Grid Reference:	E202710 N159897
Viewpoint elevation	200m
Nearest proposed Upperchurch turbine	6.1km
No. proposed Upperchurch turbine hubs visible	13
No. proposed Upperchurch turbine blade sets visible	16
Direction of view	W





Panned view showing the cumulative visual influence of the proposed Upperchurch turbines with the existing and permitted wind farms in the area in a landscape context

Viewshed Reference Point		Direction of View	Distance to nearest turbine:	Number of turbine hubs visible:
AV4	Birch Hill looped walk	W	6.1km	13

Representative of:

- An area identified on the ZTV map as having a theoretical view of between 19 and 22 of the proposed turbines
- A signposted local loop walk – part of the national looped walk network
- Views from local roads and residences

Receptor Sensitivity **Medium**

Existing View

This is a broad and elevated vista to the west from a high point of the Birch Hill Looped Walk. The rolling upland landscape in view has a land cover that comprises a rich texture of pastoral fields and hedgerows as well as patches of woodland and geometric blocks of conifer plantation. The vista has a remote rural character.

Visual Impact of Upperchurch Wind Farm

Just over half of the proposed turbines will rise above undulating sections of the skyline ridge in two clusters divided by an intervening hilltop. The turbines are seen at a reasonable scale from here and despite the discontinuity, the lateral extent of the scheme is also considerable. In the context of this broad and rich vista the wind farm is deemed to have a co-dominant visual presence.

The proposed turbines are relatively well displayed form here with most of them rising fully in silhouette above the skyline ridge and the profile of the scheme rising and falling in sympathy with the underlying terrain. There are a couple of instance of turbine overlap or blade sets rotating against the skyline in perspective. Overall, the magnitude of the visual impact is deemed to be medium.

Summary

Based on the assessment criteria and matrices outlined at section 9.3.2 the significance of visual impact is summarised below.

Visual Receptor Sensitivity	Visual Impact Magnitude	**Significance of Visual Impact**
Medium	Medium	**Moderate**

11.3.3 Cumulative Impacts

The Scottish Natural Heritage (SNH) Guidelines relating to the Cumulative Effects of Wind Farms (2005) identify that cumulative impacts on visual amenity consist of combined visibility and sequential effects.

> *'Combined visibility occurs where the observer is able to see two or more developments from one viewpoint. Combined visibility may either be in combination (where several wind farms are within the observer's arc of vision at the same time) or in succession (where the observer has to turn to see the various wind farms).*
>
> *Sequential effects occur when the observer has to move to another viewpoint to see different developments. The occurrence of sequential effects may range from frequently sequential (the features appear regularly and with short time lapses between, depending on speed of travel and distance between the viewpoints) to occasionally sequential (long time lapses between appearances, because the observer is moving very slowly and / or the there are large distances between the viewpoints.)'*

Cumulative impacts of wind farms tend to be adverse rather than positive as they relate to the addition of moving manmade structures into a landscape and viewing context that already contains such development. Based on guidance contained within the SNH Guidelines relating to the Cumulative Effects of Wind Farms (2005) and the DoEHLG Wind Energy Guidelines (2006) cumulative impacts can be experienced in a variety of ways. In terms of landscape character, additional wind energy developments might contribute to an increasing sense of proliferation. A new wind farm might also contribute to a sense of being surrounded by turbines with little relief from the view of them. The term 'skylining' is used in the SNH Guidelines to describe the effect where *"an existing windfarm is already prominent on a skyline the introduction of additional structures along the horizon may result in development that is proportionally dominant. The proportion of developed to non-developed skyline is therefore an important landscape consideration"*.

In terms of visual amenity, there is a range of ways in which an additional wind farm might generate visual conflict and disharmony in relation to other wind energy developments. Some of the most common include visual tension caused by disparate extent, scale or layout of neighbouring developments. A sense of visual ambivalence might also be caused by adjacent developments traversing different landscape types. Turbines from a proposed wind farm that are seen stacked in perspective against the turbines of nearer or further developments tend to cause visual clutter and confusion. Such effects are exacerbated when, for example, the more distant turbines are larger than the nearer ones and the sense of distance is also distorted. Table 9.8 below provides criteria for assessing the magnitude of cumulative impacts.

Table 9-8 Magnitude of cumulative impact

Magnitude of Impact	Description
Very High	• The proposed wind farm will strongly contribute to wind energy development being the defining element of the surrounding landscape. • It will strongly contribute to a sense of wind farm proliferation and being surrounded by wind energy development. • Strongly adverse visual effects will be generated by the proposed turbines in relation to other turbines.
High	• The proposed wind farm will contribute significantly to wind energy development being a defining element of the surrounding landscape. • It will contribute to a significant sense of wind farm proliferation and being surrounded by wind energy development. • Significant adverse visual effects will be generated by the proposed turbines in relation to other turbines.
Medium	• The proposed wind farm will contribute to wind energy development being a characteristic element of the surrounding landscape. • It will contribute to a sense of wind farm accumulation and dissemination. • Adverse visual effects might be generated by the proposed turbines in relation to other turbines.
Low	• The proposed wind farm will be one of only a few wind farms in the surrounding area and will viewed in isolation from most receptors. • It might contribute wind farm development becoming a familiar feature within the study area. • The design characteristics of the proposed wind farm accord with other schemes within the surrounding landscape and adverse visual effects are not likely to occur in relation to these.
Negligible	• The proposed wind farm will most often be viewed in isolation or occasionally in conjunction with other distant wind energy developments. • Wind energy development will remain an uncommon landscape feature. • No adverse visual effects will be generated by the proposed turbines in relation to other turbines.

11.3.3.1 Cumulative Baseline

There are 4 operational wind farms and 3 wind farms currently under construction within the study area. There are also 3 other permitted wind farm developments and these are all outlined in table 9-9 below.

Table 9-9 Existing and permitted wind farms within the study area

Wind farm Name	Turbine No.	Distance and direction from proposal site	Status
Knockastanna, Co Limerick	4	8.1km S	Operating
Mienvee	1	9km SW	Operating
Garracummer	15	3.5km SW	In Construction
Falleennafinoga	2	5.5km S	In Construction
Hollyford	3	5.5km S	Permitted
Glencarbry	9	6.3 S	In Construction
Glenough	14	3.2 S	Operating
Cappagh White	18	8.5km S	Permitted
Curraghgraigue	6	9.5km N	Operating
Knockmeale	2	8.2km NW	Permitted

11.3.3.2 Department of Environment, Heritage and Local Government (DoEHLG) 'Wind Energy Development Guidelines' (2006)

The above guidelines provide direction on wind farm siting and design criteria for a number of different landscape types. This proposal site is considered to be contained within the 'Hilly and Flat Farmland' landscape type and the guidance with respect to cumulative impact in such areas is;

> *"It is important that wind energy development is never perceived to visually dominate. However, given that these landscapes comprise hedgerows and often hills, and that views across the landscape will likely be intermittent and partially obscured, visibility of two or more wind energy developments is usually acceptable".*

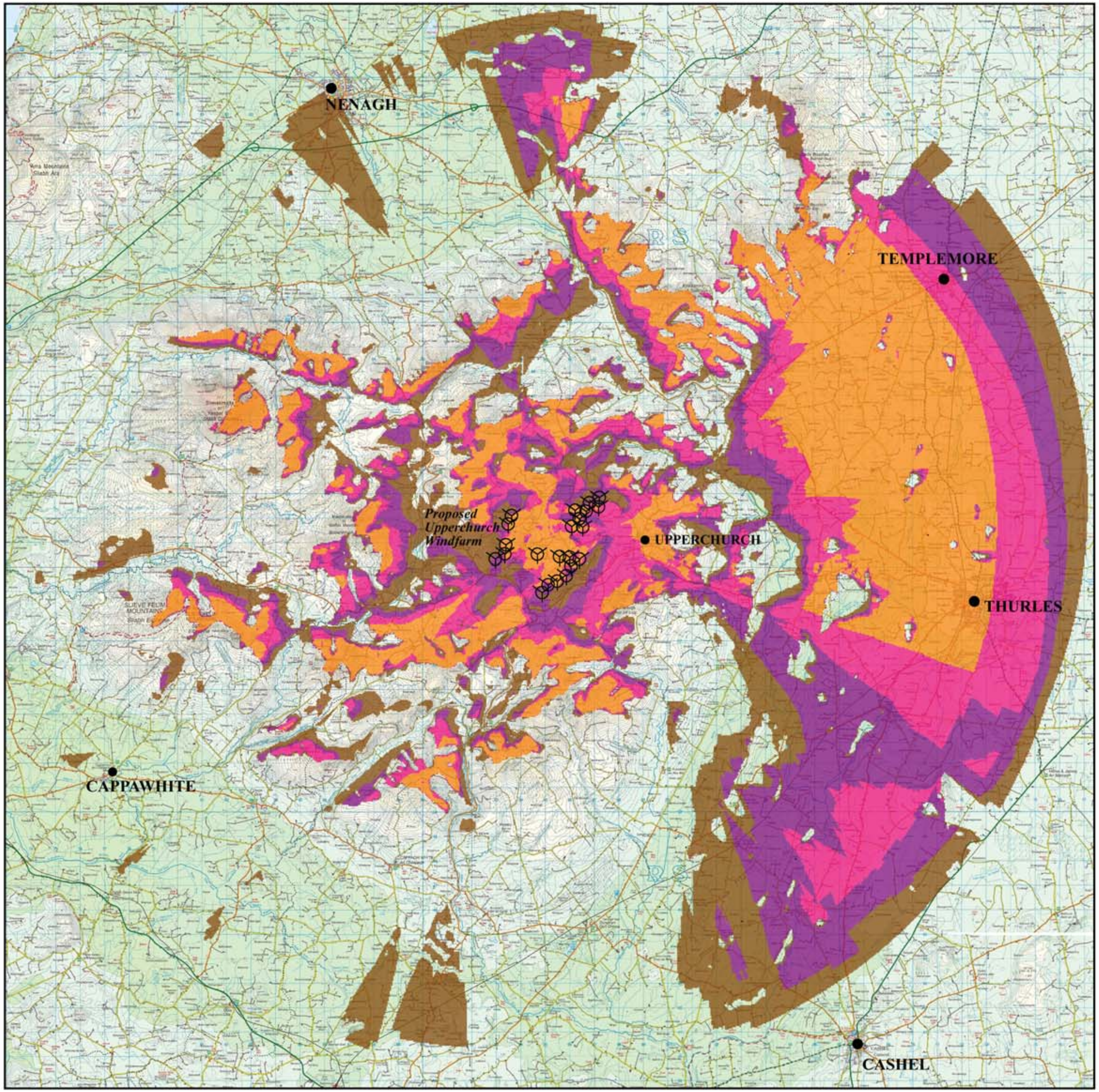


Figure 10.1

Zone of Theoretical Visibility (ZTV)
of the proposed Upperchurch turbines.

Proposed Upperchurch turbines

Colour Code:

Brown Shading: Areas where 1 - 6 Upperchurch turbines are visible (to uppermost blade tip height)

Purple Shading: Areas where 7 - 12 Upperchurch turbines are visible (to uppermost blade tip height)

Pink Shading: Areas where 13 - 18 Upperchurch turbines are visible (to uppermost blade tip height)

Orange Shading: Areas where 19 -22 Upperchurch turbines are visible (to uppermost blade tip height)

Uppermost Blade Tip Height

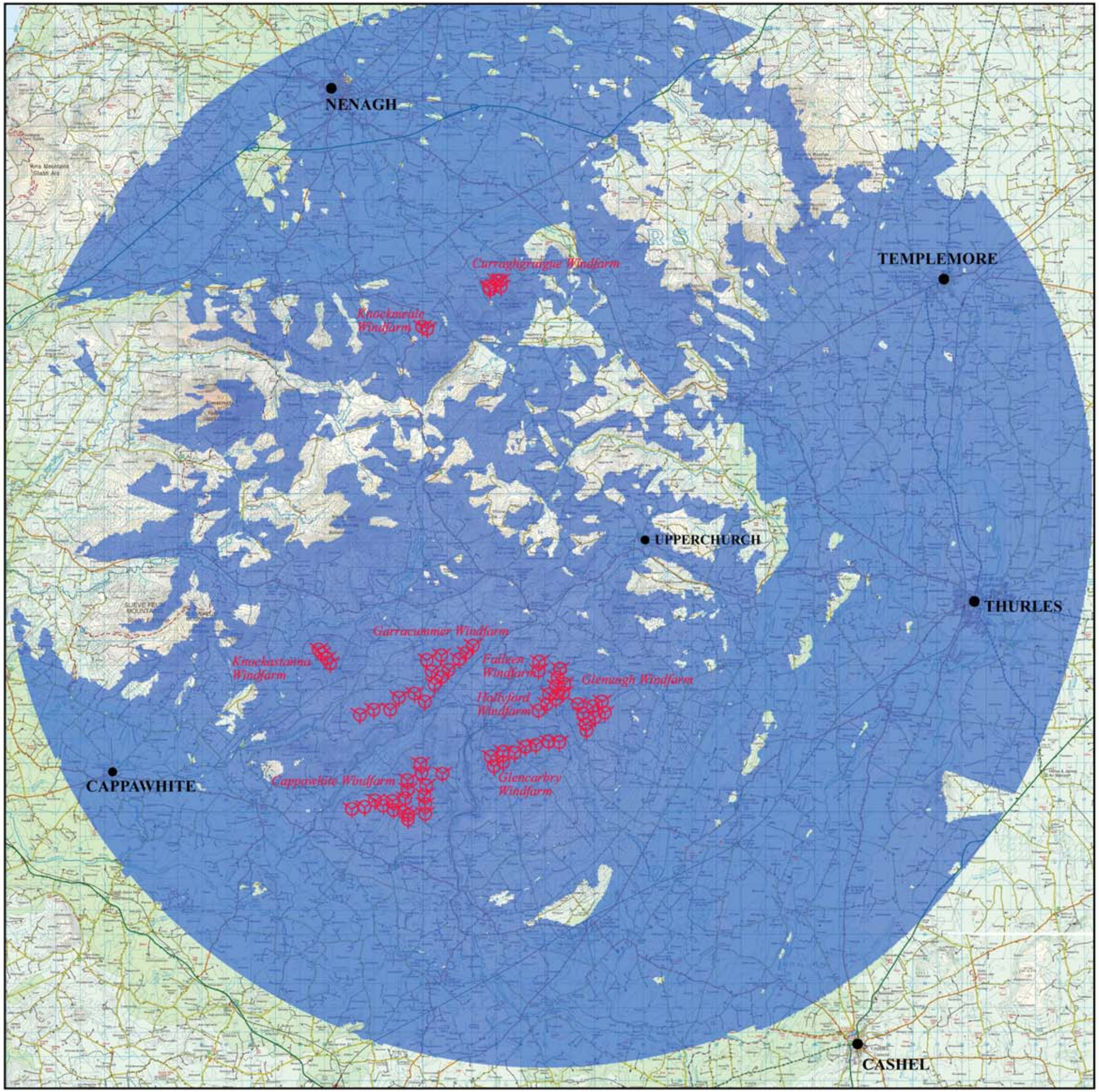
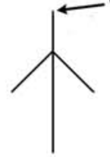


Figure 10.2 (Cumulative Study)

Zone of Theoretical Visibility (ZTV) of the existing and permitted turbines in the area.

Existing or permitted turbines as identified on the map

Colour Code:
Blue Shading: Areas where turbines from the existing and/or permitted windfarms in the area are visible to uppermost blade tip height.



Refer to Figure 10.3 for Cumulative ZTV

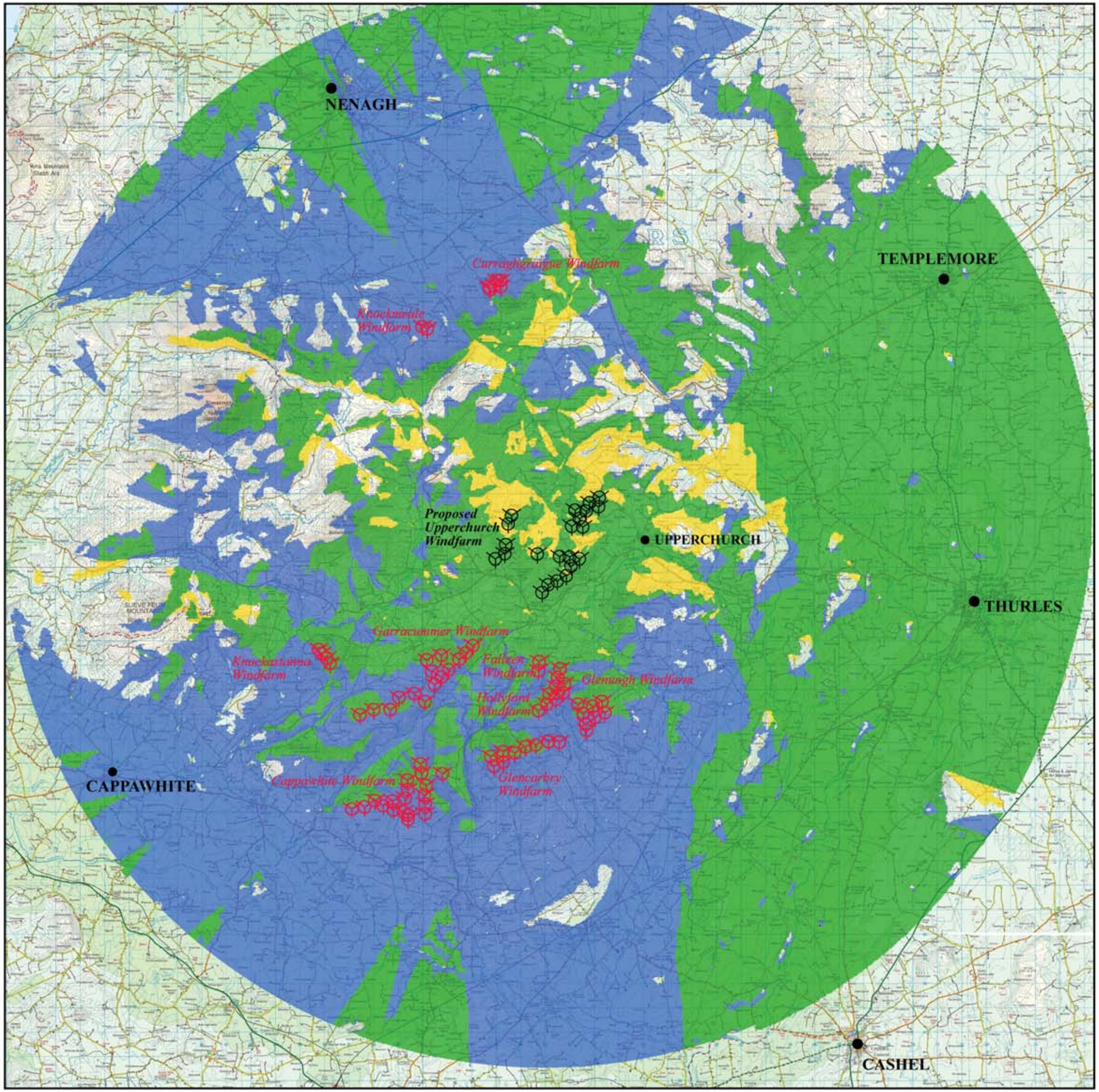


Figure 10.3 (Cumulative Study)

Zone of Theoretical Visibility (ZTV) of the proposed Upperchurch turbines along with the existing and permitted turbines in the area.

Proposed Upperchurch turbines

Existing or permitted turbines as identified on the map

Colour Code:

Blue Shading: Areas where turbines from the existing and/or permitted windfarms in the area are visible.

Green Shading: Areas where the proposed Upperchurch turbines along with turbines from the existing and/or permitted windfarms in the area are visible.

Yellow Shading: Additional areas of visibility due to the proposed Upperchurch turbines.

11.3.3.3 *Cumulative Zone of Theoretical Visibility (ZTV)*

Figure 10.1 ZTW of the Proposed Upperchurch Turbines (over)

Figure 10.2 ZTV of the existing and permitted turbines in the area(over)

Figure 10.3 ZTV of the proposed Upperchurch turbines along with the existing and permitted turbines in the area (over)

The cumulative ZTV maps indicate that;

- Despite the high density of turbines from the various existing and permitted wind farms in this part of the Slieve Felim uplands, intervisibility between them and the proposed Upperchurch Wind Farm is surprisingly limited within the rolling upland context. This is particularly true beyond 5km of the proposal site.

- Extensive visibility of the proposed Upperchurch Wind Farm in conjunction with multiple other wind farms emerges within the lowlands to the east and south beyond where the foothills of the range no longer screen the primary ridgelines from view (approximately 5km east of the R661 alignment).

- There is a relatively small proportion of the landscape that will afford views of only the proposed Upperchurch Wind Farm and no other schemes. These areas all occur either within the confines of the development or to the northeast within approximately 8km. Notwithstanding, this is still a notable proportion of the study area given the density of development in this general upland area. Again, this reflects the absorption capacity of the rolling upland context.

The following table identifies the characteristics of the cumulative view of wind farms from each of the VRP's used earlier in the assessment of the visual impacts of the proposed scheme in its own right.

Table 9-10 Cumulative view of existing and consented wind farms from VRP's

VRP Ref.	No. of other wind farms potentially in view	Nearer or further than proposal	Combined view (within a single viewing arc)	Succession view (within a series of viewing arcs from the same location)	Sequential view (view of different developments moving along a linear receptor)
CP1	1	nearer	yes	no	no
CP2	0	-	-	-	-
CP3	1	further	no	yes	no
CP4	3	1 at a similar distance and 2 further	yes	no	no
CP5	4	1 at a similar distance and 3 further	yes	yes	no
LC1	1	further	no	yes	yes
LC2	0				
MR1	2	nearer	yes	no	no
MR2	3	All further	yes	yes	no
MR3	2	1 at a similar distance and 1 further	yes	no	yes
MR4	5	3 at a similar distance and 2 further	yes	yes	yes
DR1	0				
DR2	2	nearer	no	yes	no
DR3	1	nearer	no	yes	no
DR4					
DR5	2	1 at a similar distance and 1 further	no	yes	yes
DR6	3	1 at a similar distance and 2 further	yes	yes	no
AV1	2	Both further	yes	no	no
AV2	2	Both further	yes	no	no
AV3	0	-	-	-	-
AV4	3	1 at a similar distance and 2 further	no	yes	no

11.3.3.4 Cumulative Impact Assessment

As can be seen from table 9-10 above, cumulative effects relating to the proposed Upperchurch Wind Farm follow several patterns, which are analysed below.

From locations within the central upland spine of the study area, where the landscape is steeply undulating, there is less opportunity to see other wind energy developments except from elevated locations. Importantly, most sensitive receptors in this area, such as roads and settlements, are contained within the base of valleys. Receptors at higher elevations that are afforded potential views of multiple developments tend to be local walking routes, elevated farmsteads and lookout points. Overall it is considered that the central upland zone of the study area has a high capacity to absorb multiple and expansive wind energy developments. Currently the number of existing and permitted schemes in this area combine to make wind energy development a familiar element in this productive rural landscape, but without a significant sense of proliferation or being surrounded by turbines.

From the lowland context, particularly to the southeast, a different scenario occurs regarding cumulative effects. Whilst the foothills of the Slieve Felim upland spine tend to screen close views of multiple wind energy developments, from distances beyond approximately 5km of the base of these hills a more comprehensive view of the primary ridgeline is afforded. This in turn allows for clear, but distant views of the turbines that rise above the skyline ridge. There are a number of settlements and major routes contained within this zone that are afforded such views. Perhaps the best example of this effect is the view from MR4 at Boherlahan, where combined and succession views of the proposal in conjunction with up to 5 other schemes are afforded. This route is also subject to sequential views of different wind farms as the viewer travels along it. The key issue here is not so much the manner in which multiple schemes are viewed but the effect of 'skylining' where the proportion of developed skyline can begin to dominate the proportion of undeveloped skyline. The proposed development will noticeably contribute to this effect at MR4. It should be noted that MR4 represents a worst case scenario in this regard as the adjacent section of ridgeline is subject to the highest level of turbine accumulation within the upland spine. Clear views of significant sections of the Slieve Felim range are also often screened by foreground vegetation from within the wider lowland context.

From the lowland plains to the northwest of the Slieve Felim uplands there is less opportunity to see multiple wind farm developments. This is due to most of the existing and permitted wind farms being located closer to the south-eastern edge of the upland spine. The steeply undulating Silvermines Mountains that run along the northwestern edge of the upland zone also tend to screen views of the landscape and, therefore, the wind farms beyond.

Should the proposed development proceed to construction along with all of the other permitted wind farms currently shown in the cumulative photomontages there would be an overall sense that the Slieve Felim uplands has become something of a strategic area for wind energy development.

This would not be a unique situation within the country and given the robust and productive landscape character along with the generally low level of sensitivity of surrounding receptors it is not inappropriate either.

On the basis of the factors outlined above, the additional cumulative impact represented by the proposed development is deemed to be **medium**.

11.4 MITIGATION MEASURES

Given the highly visible nature of commercial wind energy developments it is not generally feasible to screen them from view using on-site measures as would be the primary form of mitigation for many other types of development. Instead, landscape and visual mitigation for wind farms must be incorporated into the early stage site selection and design phases. A principle consideration in this regard was the Department of Environment Heritage and Local Government's Wind Energy Development Guidelines (2006).

11.4.1 Department of Environment, Heritage and Local Government Wind Energy Development Guidelines (2006)

The Wind Energy Development Guidelines (2006) provide guidance on wind farm siting and design criteria for a number of different landscapes, including 'Hilly and Flat Farmland' similar to the context for the proposed Upperchurch Wind Farm. Recommendations in the guidelines for this landscape type include the following:

Location – "Although hilly and flat farmland type is usually not sensitive in terms of scenery, due regard must be given to houses, farmsteads and centres of population."
"Location on ridges and plateaux is preferred…"
"Elevated locations are also more likely to achieve optimum aesthetic effect."

Spatial extent - "This can be expected to be quite limited in response to the scale of fields and such topographic features as hills and knolls"

Spacing - "The optimum spacing pattern is likely to be regular, responding to field pattern…However … a balance will have to be struck between adequate spacing to achieve operability and a correspondence to field pattern."

Layout - "The optimum layout is linear, and staggered linear on ridges and hilltops but a clustered layout would also be appropriate on a hilltop"

Height - "Turbines will tend not to be tall … the more undulating the topography the greater the acceptability of an uneven profile."

The design of the proposed wind farm is in general accordance with all of the design criteria outlined above except that relating to spatial extent. However, in this instance there is clear direction from the North Tipperary County Development Plan that a broader extent of development will be sought in this landscape character area than is provided for in the guidelines for 'Hilly and Flat Farmland'. Furthermore, the fact that the development is relatively dispersed across four elevated areas reduces its intensity, particularly at local receptors where views of discreet clusters of turbines are more commonplace than of the full scheme.

A number of general mitigation measures are also included below:

- Matt non-reflective finishes will be used on all turbine components;
- Transmission lines between individual turbines and the substation will be placed underground;
- Counter rotation of blade sets will be avoided;
- The number and extent of new access tracks will be kept to a minimum and properly landscaped immediately following completion of works. Such landscaping will include reinstating original vegetation along verges and repairing any wheel ruts;
- Special care will be taken to preserve any features, which contribute to the landscape character of the study area. Any damage to existing hedgerows from transporting the turbines will be rectified; and
- Turbines will be the same size as existing turbines in the area

A high standard of design will be applied to all structures associated with the substation considering not only its function but also the aesthetic quality, in order to minimise
any sense of intrusion. The proposed development will provide colour harmony and adequate screening of the substation using berms covered with scrub and ground vegetation in order to mitigate its impact.

11.5 RESIDUAL IMPACTS

Landscape and visual mitigation measures have been incorporated into the design of the scheme from its early stages. Therefore, the proposed wind farm presented as the subject of this application already incorporates any substantial landscape and visual mitigation measures. Unlike for many of the other EIA topics, the residual impacts of the proposed wind farm are essentially the same as assessed in the predicted landscape and visual impacts section (9.3) above.

11.6 CONCLUSION

A summary table is provided below, which collates the assessments of landscape and visual impacts. A discussion of the results is provided thereafter.

Table 9-11: Summary Impact Assessment

Landscape Impact			
Landscape Sensitivity		**Landscape Impact**	**Landscape impact Significance**
Low		Low	**Minor-negligible**
Visual Impact			
VRP	**Visual Receptor Sensitivity**	**Magnitude of visual impact**	**Visual Impact Significance**
CP1	Low	Negligible	**Negligible**
CP2	Low	medium	**Minor**
CP3	Low	High	**Moderate-minor**
CP4	Low	Medium	**Minor**
CP5	Low	Low	**Minor-negligible**
LC1	Medium	Medium	**Moderate**
LC2	Medium	Low	**Minor**
MR1	Low	Negligible	**Negligible**
MR2	Low	Medium	**Minor**
MR3	Low	Low	**Minor-negligible**
MR4	Low	Medium	**Minor**
DR1	Medium	Medium	**Moderate**
DR2	Medium	Medium	**Moderate**
DR3	Medium	Medium	**Moderate**
DR4	Medium	Medium	**Moderate**
DR5	Medium	Medium	**Moderate**
DR6	Medium	low	**Minor**
AV1	Medium	High	**Major-moderate**
AV2	High	Medium	**Major-moderate**
AV3	Medium	Medium	**Moderate**
AV4	Medium	Medium	**Moderate**
Cumulative Impact			**Medium**

11.6.1 Landscape Impacts

The assessment of landscape impacts is based on a comparison of landscape sensitivity against the magnitude of effects on the physical landscape and on landscape character. In this instance the judgement of sensitivity is 'low'. This is mainly due to the robust and productive rural character of the receiving landscape and the influence of existing wind energy developments on that character.

The magnitude of the landscape impact is also considered to be 'low' on the basis that the proposed wind farm represents a familiar form, scale and intensity of development in an area where the scale of the terrain and land use patterns is such that even this relatively extensive proposal will not be overly dominant. The wind farm is not considered to have a physical impact on the site in excess of that experienced for surrounding forestry operations and the prevailing site land uses will be maintained below the turbines. On the basis of the judgements relating to landscape sensitivity and the magnitude of the landscape impact expected from this proposal, the overall significance of impact on the landscape is deemed to be 'Minor-negligible'.

11.6.2 Visual Impacts

Visual impacts were assessed on the basis of visual receptor sensitivity versus the magnitude of the visual impact. The magnitude itself is the function of the visual presence of the proposal and its effect on visual amenity. Visual impacts were assessed at 22 visual receptors throughout the study area.

As can be seen from the summary table above, visual receptor sensitivity generally varied between medium and low with these judgements being relatively evenly shared. Only one of the VRP's was attributed High sensitivity. The High sensitivity rating occurred at AV2 which is a local signposted lookout point that affords vast panoramic views over both the Slieve Felim uplands to the west and the lowland plains to the east.

Notably, none of the designated scenic routes is attributed a sensitivity judgement of higher than medium. This is on the basis that the sensitivity of a receptor is not wholly synonymous with the scenic quality of the view on offer, but also many other factors such as the likely mind set of the viewer and the popularity of the location. Many of the designated scenic routes relate to the provision of elevated or broadly panoramic vistas over the landscape. The value of such vistas relates directly to the vast nature of the view as opposed to the naturalistic or unique qualities of the scene, elements of the picturesque or a strong sense of place. Therefore, such views are most sensitive to visual obstruction (Blocking of the view) and not necessarily visual intrusion (an additional element within the view).

In terms of the magnitude of visual impacts, the relative visual dominance of the scheme from each VRP is strongly related to viewing distance in this instance. It also tends to relate to whether the view of the scheme is uphill or downhill and how vast the overall vista is. Where other wind farms are in view the proposed scheme is also generally considered to be less of a distinctive feature in the landscape. Notably, there are very few locations that afford views of all 22 of the proposed turbines at once due to the steeply rolling nature of the terrain surrounding the site. The view of only a limited number of turbines tended to moderate the visual presence of the scheme, especially in close proximity (<5km). Aesthetically speaking, the proposed development is well designed for this site with a sprawling layout and undulating profile that reflects the scale and form of the underlying terrain as well as the loosely structured land use patterns in the vicinity. For these reasons the magnitude of the visual impact is only considered to be higher than medium in two instances (AV2 and CP3), which are both less than 2km from the nearest turbines. This level of visual impact is almost unavoidable in such close proximity to commercial scale wind energy developments.

11.6.3 Cumulative Impacts

There is a reasonable accumulation of wind farms within the upland spine that runs through the centre of the study area. Views of multiple wind energy developments tend to be limited from within the steeply rolling terrain of this upland zone. Contrastingly, views of multiple developments are afforded from some locations within the plains to the southeast, where the turbines are seen to rise above the primary skyline ridge. In some instances the extent of wind farm development along the ridge is beginning to dominate the extent of undeveloped ridgeline creating an effect referred to as 'skylining' in the Scottish Natural Heritage Guidelines relating to the Cumulative Effects of Wind Farms (2005). The proposed development is considered to contribute noticeably to this effect at one of the VRP's (MR4), but this is a worst case scenario within the lowland area where unimpeded views of long sections of the skyline ridge are otherwise uncommon between hedgerows. The intervening peak of Knockalough also breaks up the line of turbines when viewed from much of the lowland area to the southeast. On balance of these factors the additional cumulative effect generated by the proposed Upperchurch Wind Farm is deemed to be of a medium level.

11.6.4 Overall Significance of Impact

In terms of the significance of impact, the majority of judgements across all assessment categories are in the mid to lower order of magnitude (Moderate to negligible). Only at two of the visual receptors that are both in very close proximity to the proposal is the significance of the visual impact judged to be major-moderate. This is on the basis of a medium sensitivity rating coupled with a high visual impact magnitude and vice versa. Whilst this represents the highest level of impact in this assessment it is only in the mid to high order of magnitude in terms of the visual impact significance matrix (table 9-7). On the basis of these reasons it is considered that the proposed Upperchurch Wind Farm represents an acceptable level of landscape and visual impact across the study area. It also complies with all of the relevant policies and guidelines for the receiving landscape in relation to wind energy developments.

KILKENNY ARCHAEOLOGY
Archaeological Consultants

UPPERCHURCH WINDFARM

CHAPTER 12

CULTURAL HERITAGE

KILKENNY ARCHAEOLOGY

12 Parliament street
Kilkenny City

12 Cultural Heritage

12.1 INTRODUCTION AND METHODOLOGY

This chapter of the EIS assesses the receiving environment in terms of its cultural heritage. It details the methodology which was employed in the assessment and documents the recorded cultural heritage of the study area. The potential impact of the proposed scheme on the cultural heritage is outlined, as are mitigation measures to ameliorate any adverse affects.

The material contained within the document is based on the *Guidelines on the Information to be Contained in Environmental Impact Statements* (E.P.A. 2002, 2003), and conforms to the methodologies recommended in 'Framework and Principles for the Protection of the Archaeological Heritage' issued by the Dept. of Arts, Heritage, Gaeltacht and the Islands (1999). Section 3.6.6 of 'Framework and Principles for the Protection of the Archaeological Heritage' notes '*Environmental impact assessment should unless there are substantial grounds to show that it is not necessary, involve the carrying out of archaeological assessment including, where appropriate, test excavation'* (Dept. of Arts, Heritage Gaeltacht and the Islands 1999). All recommendations conform to the legislative frameworks of the *National Monuments Acts 1930-1994*, *Heritage Act 2000* and the *European Convention on the Protection of the Archaeological Heritage (ratified by Ireland 1997).*

This assessment comprises a desk-based study and a field survey of the subject area.

12.1.1 Desk based study methodology

A geographic information system (GIS) was used to manage the datasets relevant to the archaeological study and for the creation of all the maps in this section of the EIS. This involved the overlaying wind turbines locations and site extent upon georeferenced aerial photographs, contour maps, digital surface models, present day maps and historical maps. The integration of all this spatial information allowed for the accurate measurement of distances of sites from cultural heritage sites. It also aided in the field survey with accurate maps being produced for use on site. Visual analyses were undertaken in GIS for two purposes: 1) to determine which cultural heritage sites the proposed windfarm would be visible from and 2) to help interpret archaeological site distribution patterns. Visual analysis of the turbines took into account their height of 126.6m.

Primary sources

The Record of Monuments and Places for Co. Tipperary was consulted for the relevant parts of North Tipperary Ordnance Survey 6" Sheets 33, 34, 39 & 40 and South Tuippperary 6" Sheets 39 and 45 . The relevant files for these sites, which contain details from aerial photographs, early maps, OS memoirs, OPW

Archaeological Survey notes and other relevant publications, were inspected in the Sites and Monuments Records Office.

The following documentary sources were also examined;

- Topographical Files and Finds lists of the National Museum of Ireland
- 1st edition OS 6 inch mapping (1843) on www.OSI.ie
- 2nd edition OS 25 inch mapping (1905) supplied by client
- Griffiths Evaluation map, 1847-1864
- Discovery Series 1:50,000 mapping supplied by client
- Aerial photographs from 1995, 2000 and 2005 (on www.osi.ie), 2012 (Google Earth) and aerial photograph supplied by client
- Excavations bulletin at www.excavations.ie
- National Inventory of Architectural Heritage (NIAH) for Fingal
- North Tipperary County Development Plan 2010-2016
- Secondary sources (see bibliography)

12.1.2 Field survey methodology

Field inspection is undertaken with the aim of identifying any potential impacts that the proposed development may have upon identified/previously unidentified archaeological sites/areas of archaeological potential that lie within or without the proposed development area. Each field was inspected and photographed. Recorded archaeological sites within close proximity of the proposed development area were visited. *Pro forma* record sheets were employed to record information on local topography, landuse, areas of archaeological and/or architectural significance/potential and any folklore connected with the locale.

12.2 RECEIVING ENVIRONMENT (BASELINE)

This assessment focused on the cultural heritage within the area of the proposed development and also that of the surrounding landscape to a distance of *c.*4km from the centre of the development. In certain instances, archaeological sites of interest beyond this area were also consulted. The following townlands were studied as the proposed development falls within them: Coumnageeha, Foilnaman, Gleninchnaveigh, Graniera, Grousehall, Knockcurraghbola Commons, Knockmaroe, Knocknamena Commons and Shevry.

12.2.1 Results of desk based study

12.2.1.1 Location and Topography

The development area lies 2km west of the village of Upperchurch in the Silvermine mountains (Figure 12.1). The mountains comprise many rounded peaks of c.300-400m elevation, with intervening valleys of sloping pasture and winding rivers and streams (Plate 12.1). The mountains extend over an area of c.22km WE by c.15km NS. The Hollyford Formation is the main geological unit of the area. It is a formed of greywacke, siltstone and grit. Upperchurch village is on the eastern margins of the mountains. It lies just north of the main road between Limerick and Thurles, which disects the mountains from west to east. The proposed development almost borders the village of Milestone on its southwestern extent. Milestone is on the road from Tipperary to Nenagh, which passes from north to south through the Silvemine mountains.

PLATE 12-1: PROPOSED DEVELOPMENT AREA. GENERAL VIEW S TOWARDS AN EXISTING WINDFARM FROM AREA C.

The proposed development is set out over four areas. For the purposes of the archaeological field survey these areas have been designated A, B, C and D. The wind turbines of areas A-C are located on three separate peaks of similar elevation while Area D is in a lowland setting. The four areas span eight townlands in Kilnamanagh Upper Barony, Upperchurch CivilParish: Coumnageeha, Gleninchnaveigh, Graniera, Grousehall, Knockcurraghbola Commons, Knockmaroe, Knocknamena Commons and Shevry. The townlands comprise predominantly pasture fields, forestry and frequent areas of bog/reeds. The area is rural with a dispersed and low population.

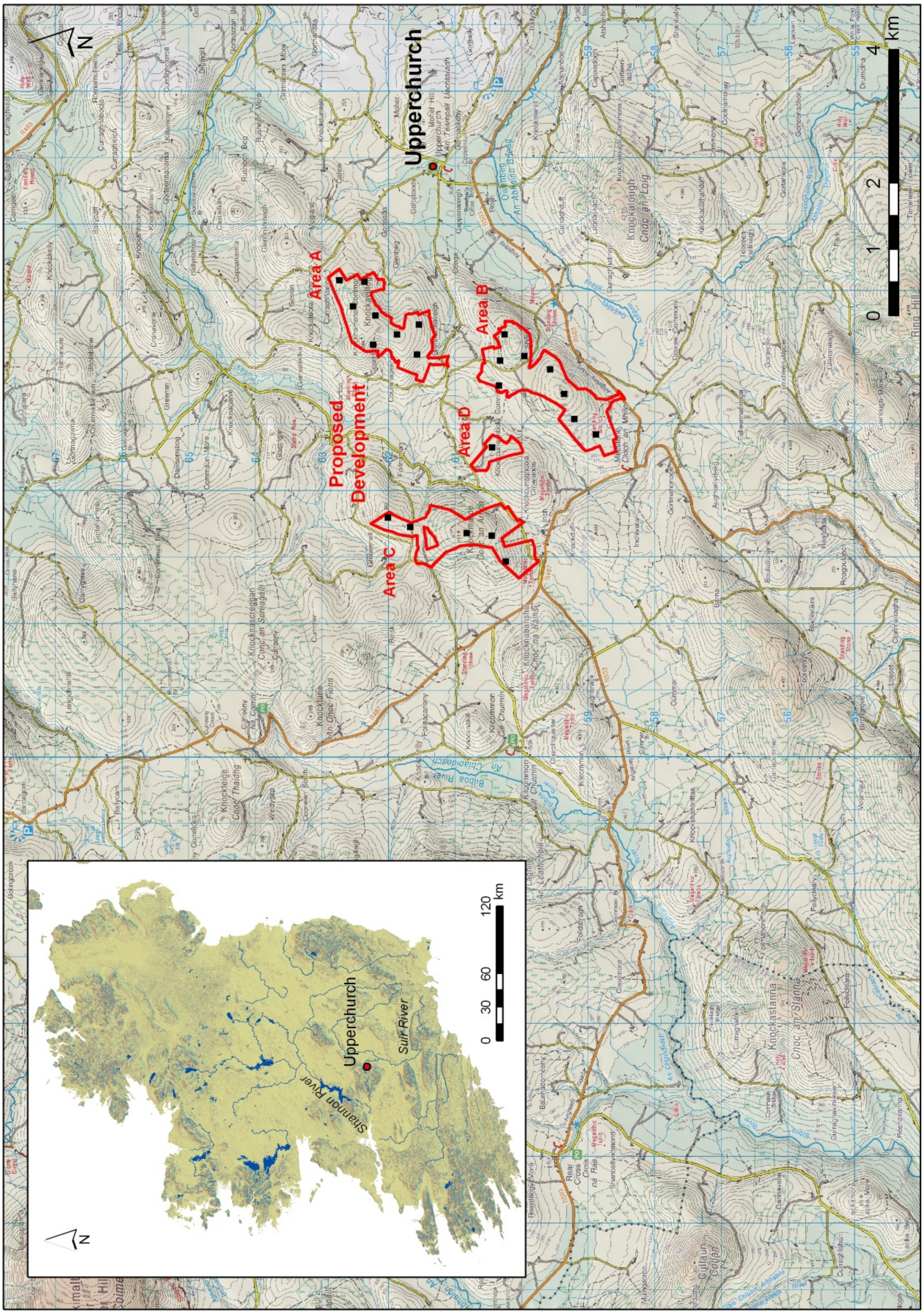


FIGURE 12-1: SITE LOCATION MAP. THE PROPOSED DEVELOPMENT AREA BEGINS C.2KM WEST OF UPPERCHURCH

12.2.1.2 General Archaeological and Historical Background

The proposed windfarm of Upperchurch is located in a region where there is a relatively high concentration of archaeology: there are 101 Recorded Monuments within a 4km radius of the development – herein known as *the study area*. Of these monuments, 71 are situated within 2km of the development. Further to the west there are more upland archaeological sites although these become less concentrated. In 1959, Michael O'Kelly from the Department of Archaeology, University College Cork, excavated one of the most visually impressive monuments in the region, the prehistoric Wedge tomb of Baurnadomeeny (RMP TN038-009), which is located 8km west of Turbine-20 (O'Kelly 1959; 1961). The monuments of Tipperary were surveyed in the early 1980s by the Archaeological Survey of Ireland (see Appendix 12-I) for a list of every within 4km of the proposed development). A review of prehistoric archaeology in Tipperary undertaken by Richard Raleigh (1985) highlighted the prehistoric richness of this North Tipperary region, while between 1992 and 1995 the North Munster Project of the Discovery Programme sought to understand settlement patterns over a vast 7000km^2 area that centred on the lower Shannon catchment (Grogan 1996). None of the North Munster Project case studies centred on Upperchurch but their results offer insights into the wider nature of prehistoric settlement in the area. An Archaeological Inventory for Counbty Tipperary was published in 2002 (see Farrelly and O'Brien 2002)

The Neolithic period sees the first evidence of human settlement in the study area. There is no evidence of earlier Mesolithic hunter-gatherer occupation. While people in the Neolithic were predominantly farmers and lived in rectangular or oval shaped wooden houses, it is their megalithic tombs and cairns which leave a lasting visual impression in the landscape. A court tomb at Shanballydesmond (RMP TN038-013), 8km west of the proposed development area, is the oldest known Neolithic monument in Tipperary (Raleigh 1985). Excavations by Kelly in 1958 inside the tomb yielded six unburnt or cremated human remains and tools of flint and chert. The tomb itself sits at high point in the landscape overlooking the Bilboa River. Another probable Neolithic monument class is a cairn, and four such monuments lie between 2.5 and 5km of the proposed development. The nearest one, Gortnaskehy, (RMP TN040-039002) to the east is within the study area. It is high on a summit and contains a cist burial (Figure 12.2).

The Early Bronze Age period is represented in the study area by three main site types: Wedge tombs (n = 6), barrows (n = 25) and fulachta fiadh (n = 11). The most prominent and complete of the wedge tombs is Knockcurraghbola Commons (TN039-009), which is 740m NW of Turbine 8 and sits on a the southern slopes of a small knoll. The tomb is 7m long and decreases in height and width from SW-NE (Plate 12.2). A complex of four tombs – two of which are Wedge tombs – are located 1.5m SW of the Knockcurraghbola Commons tomb (RMP numbers TN039-016/017/037/045) are also in this townland. The first one is the most preserved of this group. These are on lower mountain slopes and overlooked by many of the wind turbines, which start c.700m away (see Table 12.1 and Plates 12.3 to 12.7). These tombs were visited as part of the field survey as was TN039-050, another megalithic tomb in the townland.

Elksewhere, excavations at the aforementioned Baurnadomeeny Wedge tomb by O'Kelly yielded 21 burials and a range of flint tools (Raleigh 1985). A distribution analysis of the tombs of the study area and those as far away as Baurnadomeeny revealed that these types of burial monuments were not on the summits of hills like in the Neolithic but were more generally on lower lying, sloping land. The Wedge tombs are associated with a series of rivers and streams that ultimately flow into the River Shannon, with the exception of the Knockcurraghbola Commons group, which are at the juncture where streams flow to both the Bilboa River (and on to the Shannon) and the Turraheen River, which connects with the Suir River.

PLATE 12-2: TN039-009, WEDGE TOMB, FROM E. THIS IS LOCATED N OF AREA D

PLATE 12-3: TN039-0016, MEGALITHIC TOMB, FROM NE

PLATE 12-4: TN039-017, MEGALITHIC TOMB, FROM NE

PLATE 12-5: TN039-037, MEGALITHIC TOMB, FROM SE

PLATE 12-6: TN039-045, MEGALITHIC TOMB, FROM W

PLATE 12-7: TN039-050, MEGALITHIC TOMB, FROM NW

A strikingly different pattern is evident with the distribution of barrow monuments (Bronze Age/Iron Age burial mounds) in the study area (Figure 12.2, Plate 12.8). A viewshed analysis carried out as part of this desk-study shows that 23 of 25 barrows overlook rivers and streams that drain into the River Suir. While it cannot be certain that the barrows all relate to the Early Bronze Age, the fact that they juxtapose the Wedge tomb locality suggests that this form of burial monument was contemporaneous. Figure 12.3 shows that not a single Wedge tomb overlooks a barrow within the 4km study area, and only one beyond it. The TN039-009 Wedge tomb of Knockcurraghbola Commons is not only the most intact tomb of the study area but it also the most significantly positioned, being at the frontier with the barrow monument tradition: the next nearest Wedge tomb to the east is 30km away. Interestingly, the viewshed analysis shows that the monument is hidden from view the numerous barrows to its north and east. One barrow, no longer extant, is located inside the proposed development area (see discussion of TN039-046 in the next section).

PLATE 12-8: TN039-0388001, RING BARROW, FROM SW

To make sense of such site distribution patterns, Raleigh (1985) had proposed that the Wedge tomb builders were pastoral and the barrow builders more agrarian, exploiting fertile alluvial soils. He observed that mineral resources may have been an attraction for settlement in the upland region. No mines are recorded in the study area; there is a prehistoric copper mine 14km west of Turbine-17 in Lackamore (TN038-020). Figure 12.2 shows that the fulachta fiadh distribution is notably linked to the River Suir tributaries and as such they may be associated with the Early Bronze Age barrow builders. Some examples are intact, such as TN040-048 (Plate 12.9).

The Middle Bronze Age period is represented in the study area by standing stones (n = 12, examples: Plate 12.10 – 12.13), stone rows (n = 2) and a single stone circle. The stone circle (RMP TN039004-001) was marked on the second edition mapping (1905) at Reisk but it no longer survives. Three impressive stone circles are still upstanding 7-12km west/northwest of the development area at Bauraglanna, Reardnogy More and Cooneen. The latter is a variant known as a Kerb Circle (RMP TN033-047), of which only 30 are known across Ireland. Distribution and viewshed analyses of the standing stones within and adjacent to the study area show a striking pattern: they are overwhelmingly placed at positions which overlook the numerous rivers and streams. Furthermore, all of the rivers with the exception of the Owenbeg has one stone per valley and these stones are not intervisible. The reason the Owenbeg River is different is because it is overlooked by six standing stones. Four of these, running NE-SW, are all theoretically intervisible, while two running NW to SE are also intervisible. The stones themselves typically ranged in height from 0.8m to 1.96m. The nearest standing stone to the proposed development is at Toorfiba (RMP TN039-001001), which is 751m WSW of Turbine-12.

PLATE 12-9: TN040-048, FULACHT FIA, FROM N

PLATE 12-10: TN039-044, STANDING STONE, FROM N

PLATE 12-11: TN039-052, STANDING STONES, FROM SE

PLATE 12-12: TN039-043, STANDING STONE, FROM NW.

PLATE 12-13: TN039-011003, STANDING STONES, FROM E

The next phase where archaeological monuments are apparent is the Early Medieval period. Seven ringforts, two possible ringforts, four enclosures and nine possible enclosures within the study area probably date from this era (Figure 12.3, Plate 12.15). The six definite ringforts range in size from 31m to 53m in diameter. Three are bivallate. The closest pair of ringforts to the proposed development area are TN040-001 and TN040-002, which are 752m and 596m east of Turbine-15 respectively. These are depicted on the second edition OS Map and still survive today, albeit slightly warn. The nearest enclosure to the proposed development is TN039-047, which is 218m ENE of Turbine-11. Overall, the distribution of ringforts and enclosures within and beyond the study area suggest a focus on the rivers that drain into the Suir. There are numerous ringforts in these areas and considerably less in the more mountainous areas to the west of the study area.

Four castles within the study area provide evidence for the Anglo-Norman encroachment into the locality. Three are probable ringworks that dates to the 12th or 13th centuries and one is a tower house, which would date to the 14th – 15th centuries. They are situated at the foothills of the mountains overlooking the Clodiagh and Owenbeg rivers but not in the upland regions, which would have remained out of Norman influence. These frontier castles appear to defend a key routeway into the mountainous regions of North Tipperary.

Moving into more recent times, no buildings are depicted in the proposed development on the first edition OS map. The Griffiths evaluation documents occupants of Coumnageeha, Foilnaman, Gleninchnaveigh, Graniera, Grousehall, Knockcurraghbola Commons, Knockmaroe, Knocknamena Commons and Shevry townlands but there is no evidence of buildings from this era within the development.

By the revision of the first edition map in 1905 a stone agricultural building is shown on Field A-1. It still stands today. Also shown on the map are low banks where 19th century structures or enclosures such as booleys once existed for housing cattle (see BH-1 to BH-5). The landuse today of the proposed development area contains a mix of pastoral and forestry. Other areas are wet and boggy.

PLATE 12-14: TN039-047, ENCLOSURE, FROM S

12.2.1.3 Cultural Heritage within the Proposed Development Area

One Recorded Monument is located within the proposed development area. This is TN039-046 in Knockanema Commons. It is a Ring Barrow and is in Area A, Field number A-28 (see Figures 12.5, 12.6, 12.13 and Plate 12.15). The recorded description is as follows: "Situated on top of high ground in upland region with good panoramic views in all directions. Much degraded monument consisting of a barely visible circular mound (diam. 8m N-S) enclosed by an inner fosse (Wth 2m; ext. D 0.2m) and slight traces of an outer bank (Wth 1m). A field boundary bisected the monument on a N-S axis. This field boundary has since been levelled. Monument is barely visible in the winter months and is probably not visible during the summer months". The monument was not visible in the field survey.

Field inspection and aerial photography failed to identify any further previously unrecorded sites within the proposed development area.

Five National Inventory of Archaeological Heritage (NIAH) within 2.5km of the proposed development area but will not be impacted upon (see Appendix 12-II). These are a mile post in the village of Milestone, and a Church, a Shrine, a School and a house in the village of Upperchurch, located 2km east of the proposed development.

Built Heritage has been recorded within the development area. (see Table 12.2 and Plates 12.16 to 12.20). These include two probable booleys (BH-1 and BH-2, two small c-shaped enclosures marked on the second edition 1905 OS Map (BH-3 and BH-5), and a rectangular enclosure (BH-4). None will be impacted by the development.

PLATE 12-15: TN039-046----, RING BARROW (NOT VISIBLE DURING SUMMER), FROM S

12-16: BH-2, POSSIBLE BOOLEYS IN FIELD B-21, FROM NE

12-17: BH-3, C-SHAPED ENCLOSURE IN FIELD A-15, FROM SE

12-18: BH-4, RECTANGULAR ENCLOSURE IN FIELD A-16, FROM N

12-19: BH-5, C-SHAPED ENCLOSURE IN FIELD B-11, FROM E

12.2.1.4 Archaeological Artefacts from the Study Area

A search of the National Museum of Ireland's *Topographical Files* revealed no archaeological artefacts from the study area.

12.2.1.5 Aerial Photography

Examination of the 2005 Ordnance Survey aerial orthophotography and air photos provided by Ecopower did not indicate any additional archaeological sites (Figures 12.6, 12.8, 12.10 and 12.12)

12.2.1.6 Cartographic Sources

The first edition 1840 and second edition 1900 1:10560 Ordnance Survey maps were examined (Figures 12.5, 12.7, 12.9, 12.11) as was the Griffith's Valuation maps. These did not indicate any additional archaeological sites within the study area, only the built heritage sites.

North Tipperary County Development Plan
No sites additional to RMPs were recorded in the RPS list of the County Development Plan within the study area.

Visual assessment
The results of the visual assessment are incorporated into Table 12.1 and 12.3. Eight out of 101 sites within the 4km study area will have intervisibilty with all 22 wind turbines.

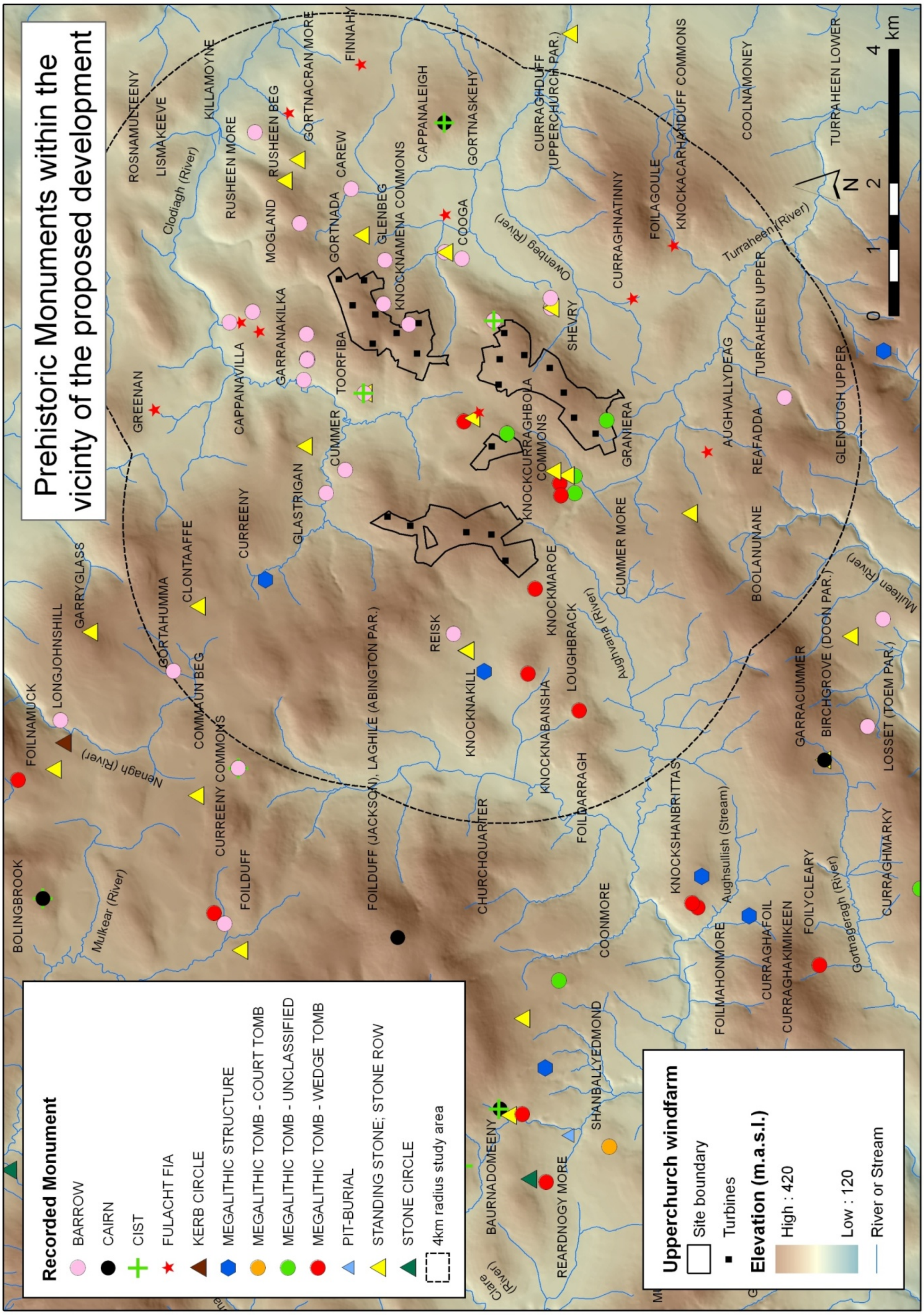


FIGURE 12-2: PREHISTORIC MONUMENTS WITHIN THE VICINITY OF THE PROPOSED DEVELOPMENT

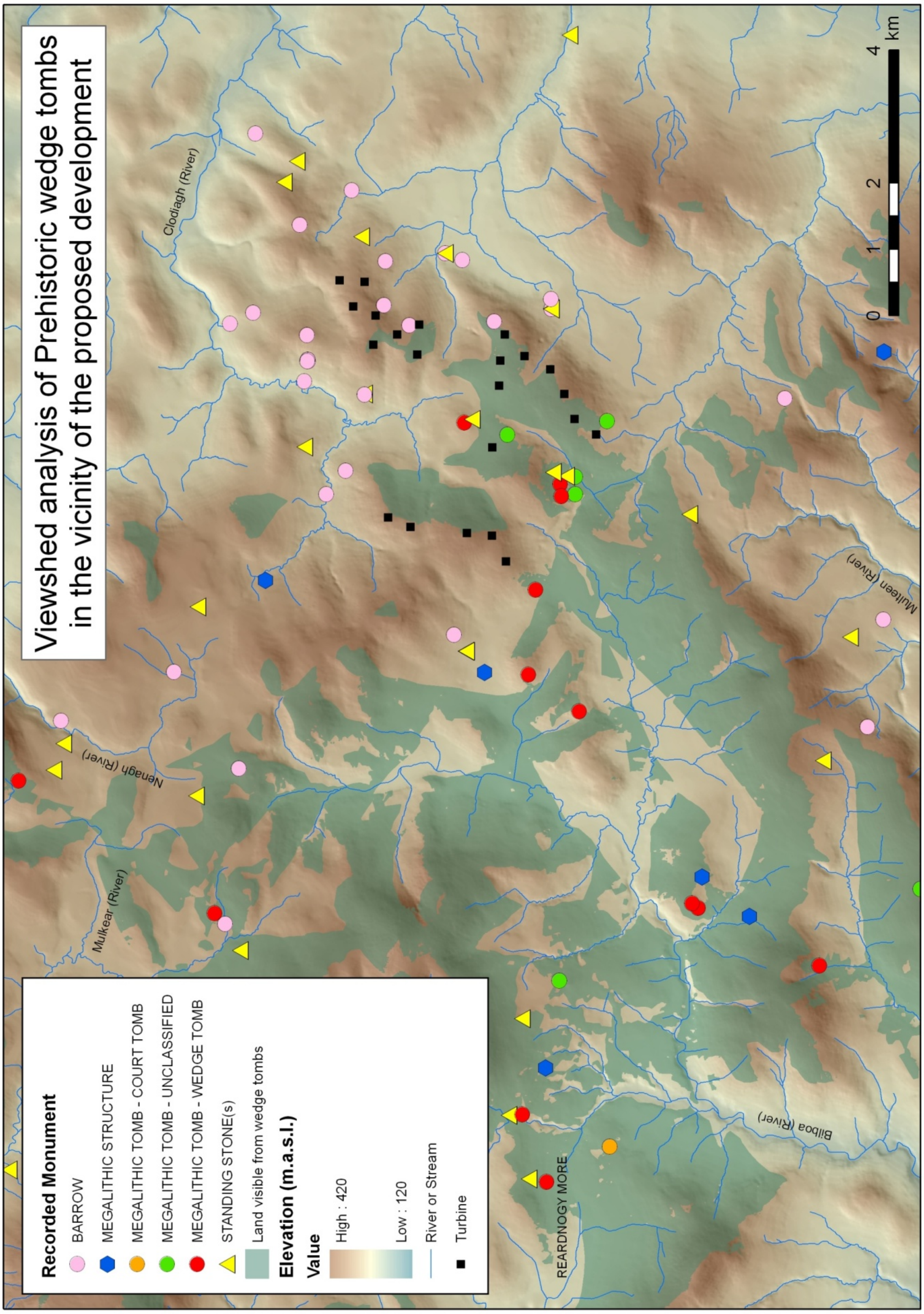


FIGURE 12-3: VIEWSHED ANALYSIS OF PREHISTORIC WEDGE TOMBS. THE AREAS SHADED GREEN REPRESENT THE CUMULATIVE TOTAL OF LAND VISIBLE FROM THE WEDGE TOMBS VISIBLE IN THE MAP.

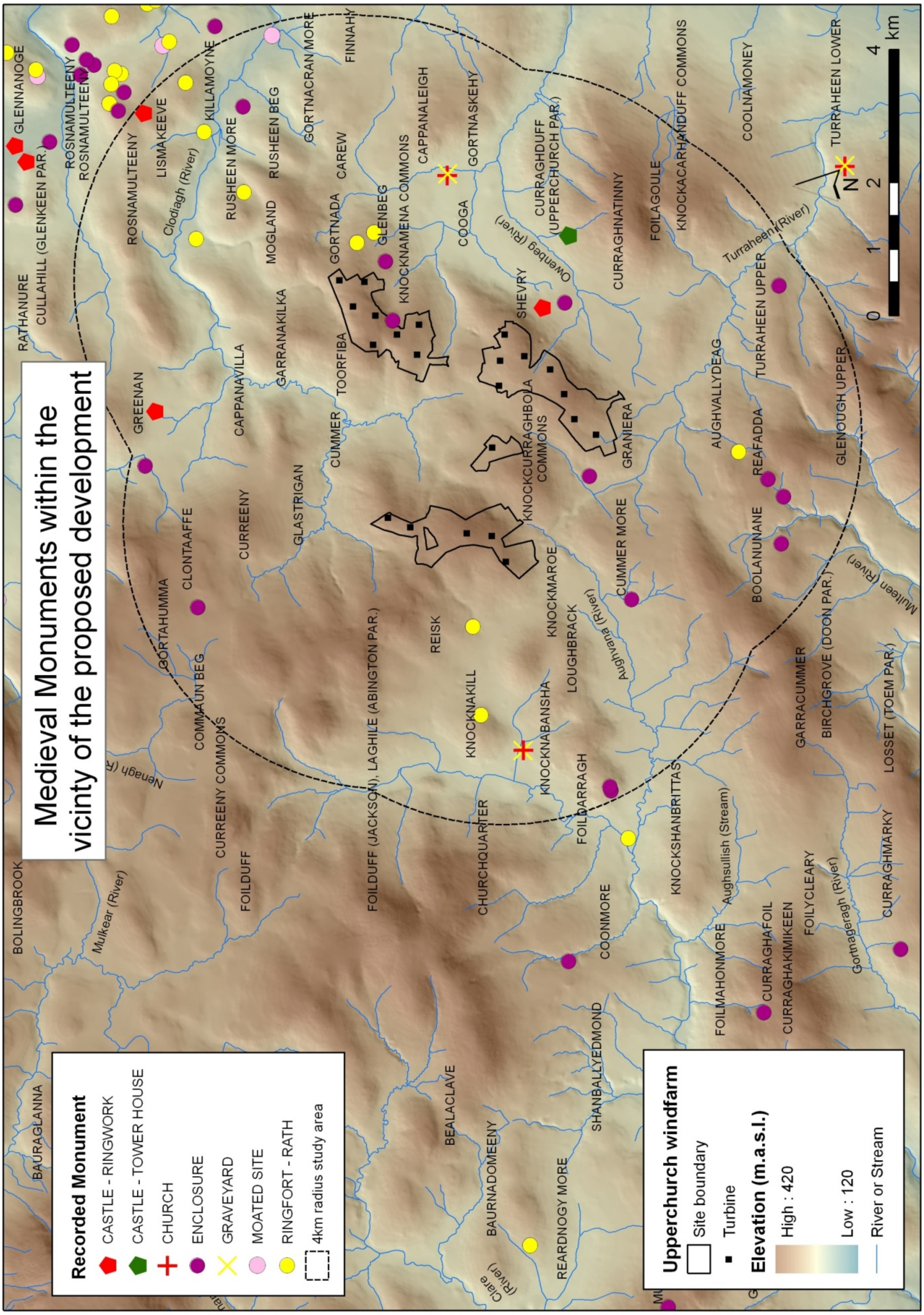


FIGURE 12-4: MEDIEVAL MONUMENTS WITHIN THE VICINITY OF THE PROPOSED DEVELOPMENT

TABLE 12-1 RECORDED ARCHAEOLOGICAL SITES WITHIN 4KM OF THE PROPOSED DEVELOPMENT (SORTED BY DISTANCE TO PROPOSED DEVELOPMENT. THE TABLE ALSO SHOWS POTENTIAL IMPACT AND RECOMMENDATIONS. A FULL DESCRIPTION OF EACH MONUMENT IS PRESENTED IN APPENDIX 1

SMR Entry	E	N	Townland	Description	Distance from nearest turbine	Number of turbine nacelles visible	Impact	Recommendation
TN039-046----	196543	161770	Knocknamena Commons	Barrow - Ring-Barrow	29.5m E of access road in Field A-28 and 143m N of T-10	15	None	Avoidance
TN039-018----	195100	158790	Graniera	Megalithic Tomb - Unclassified possible	69m SW of access road in Field B24 and 265m SW of T-1	6	None	Avoidance
TN039-048----	196849	162153	Glenbeg	Barrow - Ring-Barrow	198m SE of T-13	13	None	Avoidance
TN039-047----	196619	162022	Knocknamena Commons	Enclosure possible	218m ENE of T-11	13	None	Avoidance
TN039-038002-	196600	160490	Shevry	Cist possible	238m NE of T-6	21	None	Avoidance
TN039-038001-	196600	160490	Shevry	Barrow - Ring-Barrow	248m NE of T-6	21	None	Avoidance
TN039-050----	194897	160291	Knockcurraghbola Commons	Megalithic Tomb - Unclassified possible	286m E of T-22	22	None	Avoidance
TN039-035----	191880	161100	Reisk	Barrow - Ring-Barrow	349m NW of T-17	3	None	Avoidance
TN040-046002-	197510	162130	Knocknamena Commons	Barrow - Ditch Barrow possible	443m SE of T-15	14	None	Avoidance
TN040-046001-	197510	162130	Knocknamena Commons	Enclosure	443m SE of T-15	14	None	Avoidance
TN039-051----	195214	160729	Knockcurraghbola Commons	Fulacht Fia	501m NW of T-8	22	None	Avoidance
TN040-001----	197793	162562	Knocknamena Commons	Ringfort - Rath	596m E of T-15	15	None	Avoidance
TN039-027----	194280	159060	Graniera	Enclosure possible	630m W of T-1	17	None	Avoidance
TN039-052----	195131	160825	Knockcurraghbola	Stone Row possible	641m NW of T-8	20	None	Avoidance

			Commons					
TN040-042----	197883	162490	Gortnada	Standing Stone	680m E of T-15	19	None	Avoidance
TN039-008----	192560	159870	Knockmaroe	Megalithic Tomb - Wedge Tomb	700m SW of T-17	7	None	Avoidance
TN039-037----	194260	159270	Knockcurraghbola Commons	Megalithic Tomb - Unclassified possible	713m NW of T-1	7	None	Avoidance
TN039-009----	195079	160943	Knockcurraghbola Commons	Megalithic Tomb - Wedge Tomb	741m NW of T-8	22	None	Avoidance
TN039-001001-	195509	162446	Toorfiba	Standing Stone	751m WNW ot T-12	20	None	Avoidance
TN040-002----	197944	162305	Gortnada	Ringfort - Rath	752m E of T-15	19	None	Avoidance
TN039-001003-	195508	162455	Toorfiba	Cist	754m WNW of T-12	20	None	Avoidance
TN039-001002-	195501	162443	Toorfiba	Barrow - Ring-Barrow	759m WNW of T-12	20	None	Avoidance
TN039-044----	194270	159400	Knockcurraghbola Commons	Standing Stone	768m WNW of T-1	10	None	Avoidance
TN039-010----	196809	159771	Shevry	Castle - Ringwork possible	774m SE of T-5	7	None	Avoidance
TN039-011003-	196790	159630	Shevry	Standing Stone	813m ESE of T-5	7	None	Avoidance
TN039-011001-	196790	159630	Shevry	Barrow - Pond Barrow possible	813m ESE of T-5	7	None	Avoidance
TN039-011002-	196797	159635	Shevry	Standing Stone	823m ESE of T-5	7	None	Avoidance
TN033-064----	196397	163314	Knockatoora Commons	Barrow - Ring-Barrow possible	824m NW of T-14	18	None	Avoidance
TN039-043----	194330	159600	Knockcurraghbola Crownlands	Standing Stone possible	858m NW of T-1	7	None	Avoidance
TN039-017----	194150	159500	Knockcurraghbola Commons	Megalithic Tomb - Wedge Tomb	921m NW of T-1	8	None	Avoidance
TN039-049----	196939	159636	Shevry	Barrow - Ditch Barrow possible	954m ESE of T-5	11	None	Avoidance
TN039-045----	194000	159270	Knockcurraghbola Commons	Megalithic Tomb - Unclassified possible	957m NW of T-1	12	None	Avoidance

TN034-119----	198061	163420	Mogland	Barrow - Ring-Barrow	1009m NE of T-16	22	None	Avoidance
TN033-065----	196020	163297	Garranakilka	Barrow - Ring-Barrow possible	1010m NW of T-12	7	None	Avoidance
TN033-065001-	196023	163305	Garranakilka	Barrow - Ring-Barrow possible	1016m NW of T-12	7	None	Avoidance
TN033-065003-	196000	163299	Garranakilka	Barrow - Ring-Barrow possible	1017m NW of T-12	7	None	Avoidance
TN039-019----	196890	159430	Shevry	Enclosure possible	1020m E of T-4	13	None	Avoidance
TN039-036----	194350	162730	Cummer	Barrow - Pond Barrow	1022m NE of T-21	11	None	Avoidance
TN033-065002-	196004	163310	Garranakilka	Barrow - Ring-Barrow possible	1027m NW of T-12	7	None	Avoidance
TN033-046----	194000	163020	Glastrigan	Barrow - Mound Barrow possible	1038m NNE of T-21	10	None	Avoidance
TN039-016----	193966	159479	Knockcurraghbola Commons	Megalithic Tomb - Wedge Tomb	1068m NW of T-1	8	None	Avoidance
TN039-005----	192011	160813	Reisk	Ringfort - Rath	1093m NW of T-17	5	None	Avoidance
TN040-040002-	197630	161230	Cooga	Standing Stone	1138m SE of T10	13	None	Avoidance
TN040-040001-	197630	161230	Cooga	Barrow - Ring-Barrow	1138m SE of T10	13	None	Avoidance
TN040-047----	197530	160970	Cooga	Barrow - Ring-Barrow	1164m SE of T-10	13	None	Avoidance
TN033-063----	195701	163352	Garranakilka	Barrow - Ring-Barrow	1176m NW of T-12	12	None	Avoidance
TN033-061----	196733	164125	Cappanavilla	Barrow - Ring-Barrow possible	1382m NNW of T-16	9	None	Avoidance
TN040-003----	198580	162640	Carew	Barrow - Bowl-Barrow	1386m E of T-15	15	None	Avoidance
TN033-062----	196427	164035	Garranakilka	Fulacht Fia	1448m NW of T-16	2	None	Avoidance
TN039-054----	194926	157511		Hut Site	1472m S of T-1	14	None	Avoidance
TN039-004002-	191630	160910	Reisk	Standing Stone	1492m NW of T-17	5	None	Avoidance
TN039-004001-	191630	160920	Reisk	Stone Circle	1492m NW of T-17	5	None	Avoidance
TN039-056----	196928	158409	Curraghnatinny	Fulacht Fia	1610m SE of T-4	15	None	Avoidance
TN033-059----	196568	164312	Cappanavilla	Fulacht Fia	1620m NNW of T-16	5	None	Avoidance
TN040-048----	198190	161230	Cappanaleigh	Fulacht Fia	1669m ESE of T-10	17	None	Avoidance

TN034-118----	198707	163654	Rusheen Beg	Standing Stone possible	1689m NE of T-16	0	None	Avoidance
TN039-055----	194615	157281		Fulacht Fia	1719m S of T-1	15	None	Avoidance
TN033-027----	194710	163350	Glastrigan	Stone Row	1720m NNE of T-21	22	None	Avoidance
TN039-003----	191315	160640	Reisk	Megalithic Structure possible	1725m W of T-17	9	None	Avoidance
TN033-060----	196570	164473	Cappanavilla	Barrow - Ring-Barrow	1764m N of T-16	0	None	Avoidance
TN039-007----	191280	159980	Knocknabansha	Megalithic Tomb - Wedge Tomb	1789m WSW of T-17	0	None	Avoidance
TN039-053----	193696	157544		Standing Stone(s)	1847m SW of T-1	8	None	Avoidance
TN034-114----	199020	163460	Rusheen More	Standing Stone	1888m ENE of T-16	19	None	Avoidance
TN040-016----	197901	159386	Curraghduff (Upperchurch Par.)	Castle - Tower House	1936m ESE of T-5	18	None	Avoidance
TN034-081----	198553	164262	Castlehill, Rusheen Beg	Ringfort - Rath	1942m NE of T-14	4	None	Avoidance
TN033-042----	192700	163940	Curreeny	Megalithic Structure possible	2045m WNW of T-21	20	None	Avoidance
TS039-015----	192418	158421	Cummer More	Enclosure possible	2055m SSW of T-17	9	None	Avoidance
TS039-029----	194643	156810	Aughvallydeag	Ringfort - Rath possible	2181m S of T-1	22	None	Avoidance
TS045-004----	194230	156366	Reafadda	Enclosure possible	2231m S of T-1	0	None	Avoidance
TN034-055----	197850	164980	Ballynahow (Glenkeen Par.)	Ringfort - Rath possible	2232 NNE of T-16	8	None	Avoidance
TN040-004----	198810	161199	Cappanaleigh	Church	2286m ESE of T-10	22	None	Avoidance
TN040-004001-	198832	161192	Cappanaleigh	Graveyard	2310m ESE of T-10	22	None	Avoidance
TN039-002----	190680	160690	Knocknakill	Ringfort - Rath	2364m W of T-17	13	None	Avoidance
TN034-117----	199434	164093	Rusheen More	Barrow - Ring-Barrow possible	2525m NE of T-16	2	None	Avoidance
TN034-115----	199720	163590	Gortnacran More	Fulacht Fia possible	2587m NE of T-16	8	None	Avoidance
TN039-014----	190725	159210	Loughbrack	Megalithic Tomb - Wedge Tomb	2615m SW of T-17	8	None	Avoidance
TN040-051----	197726	157788	Foilagoule	Fulacht Fia	2618m SE of T-4	0	None	Avoidance
TN040-039002-	199580	161240	Gortnaskehy (Upperchurch	Cairn	2669m ESE of T-15	22	None	Avoidance

			Par.)					
TN040-039001-	199580	161240	Gortnaskehy (Upperchurch Par.)	Cist	2669m ESE of T-15	22	None	Avoidance
TS045-005----	193971	156135	Reafadda	Enclosure possible	2714m S of T-1	0	None	Avoidance
TN039-006002-	190150	160060	Churchquarter	Graveyard	2912m W of T-17	5	None	Avoidance
TN039-006001-	190155	160053	Churchquarter	Church possible	2912m W of T-17	5	None	Avoidance
TS045-026----	195440	156110	Turraheen Upper	Barrow - Ring-Barrow	2938km S of T-1	22	None	Avoidance
TN034-082----	199841	164281	Rusheen More	Enclosure	2991m ENE of T-16	0	None	Avoidance
TN034-056002-	199470	164900	Killamoyne	Redundant Record	3015m NE of T-16	4	None	Avoidance
TN034-056001-	199460	164860	Killamoyne	Ringfort - Rath	3056m NE of T-16	3	None	Avoidance
TN033-041002-	192300	164960	Commaun Beg	Enclosure	3135m NW of T-21	6	None	Avoidance
TN033-041001-	192300	164960	Clontaaffe	Standing Stone - Pair	3135m NW of T-21	6	None	Avoidance
TN040-052----	198055	157380	Knockacarhanduff Commons	Earthwork	3161m SE of T-4	15	None	Avoidance
TN040-041----	200452	162504	Finnahy	Fulacht Fia	3227m E of T-15	22	None	Avoidance
TS045-003----	193263	156167	Boolanunane	Enclosure possible	3240m S of T-1	22	None	Avoidance
TN033-029003-	195250	165610	Greenan	Fulacht Fia	3415m NNW of T-16	20	None	Avoidance
TN033-029002-	195250	165610	Greenan	Fulacht Fia	3415m NNW of T-16	20	None	Avoidance
TN033-029001-	195250	165610	Greenan	Castle - Ringwork possible	3415m NNW of T-16	20	None	Avoidance
TS046-001----	197145	156203	Turraheen Upper	Enclosure	3577m SE of T1	0	None	Avoidance
TN034-083----	200910	163840	Gortnahalla	Moated Site possible	3824m ENE of T-16	5	None	Avoidance
TN034-057----	199740	165780	Killamoyne, Rosnamulteeny		3869m ENE of T-16	0	None	Avoidance
TN033-026----	194430	165750	Dawsonsbog	Enclosure possible	3881m NNE of T-12	16	None	Avoidance

TN033-051----	191320	165320	Gortahumma	Barrow - Ring-Barrow possible	3923m NE of T-21	14	None	Avoidance
TN034-065----	200200	165140	Curraghcarroll, Drumgill	Ringfort - Rath	3999m NE of T-17	16	None	Avoidance

TABLE 12-2: TABLE OF BUILT HERITAGE SITES WITHIN THE PROPOSED DEVELOPMENT. THESE HAVE NO PROTECTION STATUS. THE NEAREST NIAH ARCHITECTURAL SITES WERE OUTSIDE OF THE DEVELOPMENT AREA (SEE APPENDIX 12-II).

Code	E	N	Townland	Description	Distance from nearest turbine / access road	Impact	Recommendation
B1	194897	159170	Graniera	Enclosure - possible booley - in Field B-21 marked on second edition 1905 map	129m NE of T-1	None	Avoidance
B2	194982	159051	Graniera	Enclosure - possible booley - in Field B-21 marked on second edition 1905 map	215m N of T-1	None	Avoidance
B3	197157	162477	Knockcurraghbola Commons	C-Shaped enclosure on second edition 1905 map	10m to Access road and 53m NW of T-15 in fiueld A-15	None	Avoidance
B4	197207	162475	Knockcurraghbola Commons	Rectangular possible building foundations identified in field survey – not on historic mapping	32m NE of T-15 in Field A-16	None	Avoidance
B5	195780	160313	Knockcurraghbola Commons	Foundations of possible enclosure marked on second edition 1905 map	39m S of Access Rd and 197m ENE of T-8	None	Avoidance

Table 12-3:Recorded monuments within 4km study area most overlooked by wind turbines

SMR Entry	Townland	Class	Number of turbine nacelles visible
TN039-050----	Knockcurraghbola Commons	Megalithic Tomb - Unclassified possible	22
TN039-051----	Knockcurraghbola Commons	Fulacht Fia	22
TN034-119----	Mogland	Barrow - Ring-Barrow	22
TN033-027----	Glastrigan	Stone Row	22
TN040-039002-	Gortnaskehy (Upperchurch Par.)	Cairn	22
TN040-039001-	Gortnaskehy (Upperchurch Par.)	Cist	22
TN040-041----	Finnahy	Fulacht Fia	22
TS045-003----	Boolanunane	Enclosure possible	22
TN039-009----	Knockcurraghbola Commons	Megalithic Tomb - Wedge Tomb	22
TS039-029----	Aughvallydeag	Ringfort - Rath possible	22
TN040-004----	Cappanaleigh	Church	22
TN040-004001-	Cappanaleigh	Graveyard	22
TS045-026----	Turraheen Upper	Barrow - Ring-Barrow	22
TN039-038002-	Shevry	Cist possible	21
TN039-038001-	Shevry	Barrow - Ring-Barrow	21

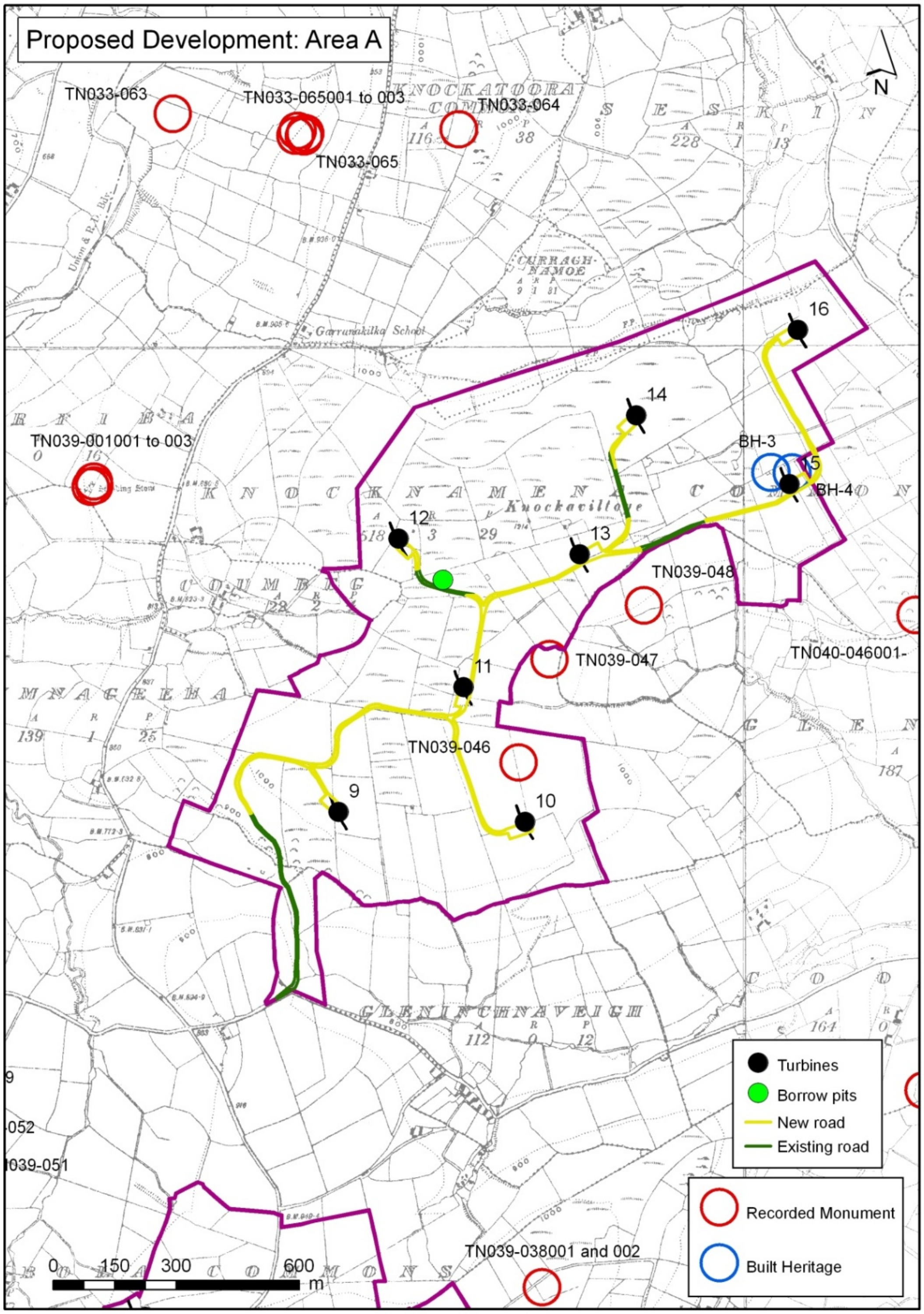


FIGURE 12-5: PROPOSED DEVELOPMENT (AREA A) AND SURROUNDING ENVIRONMENT ON 1905 2ND EDITION OS MAP

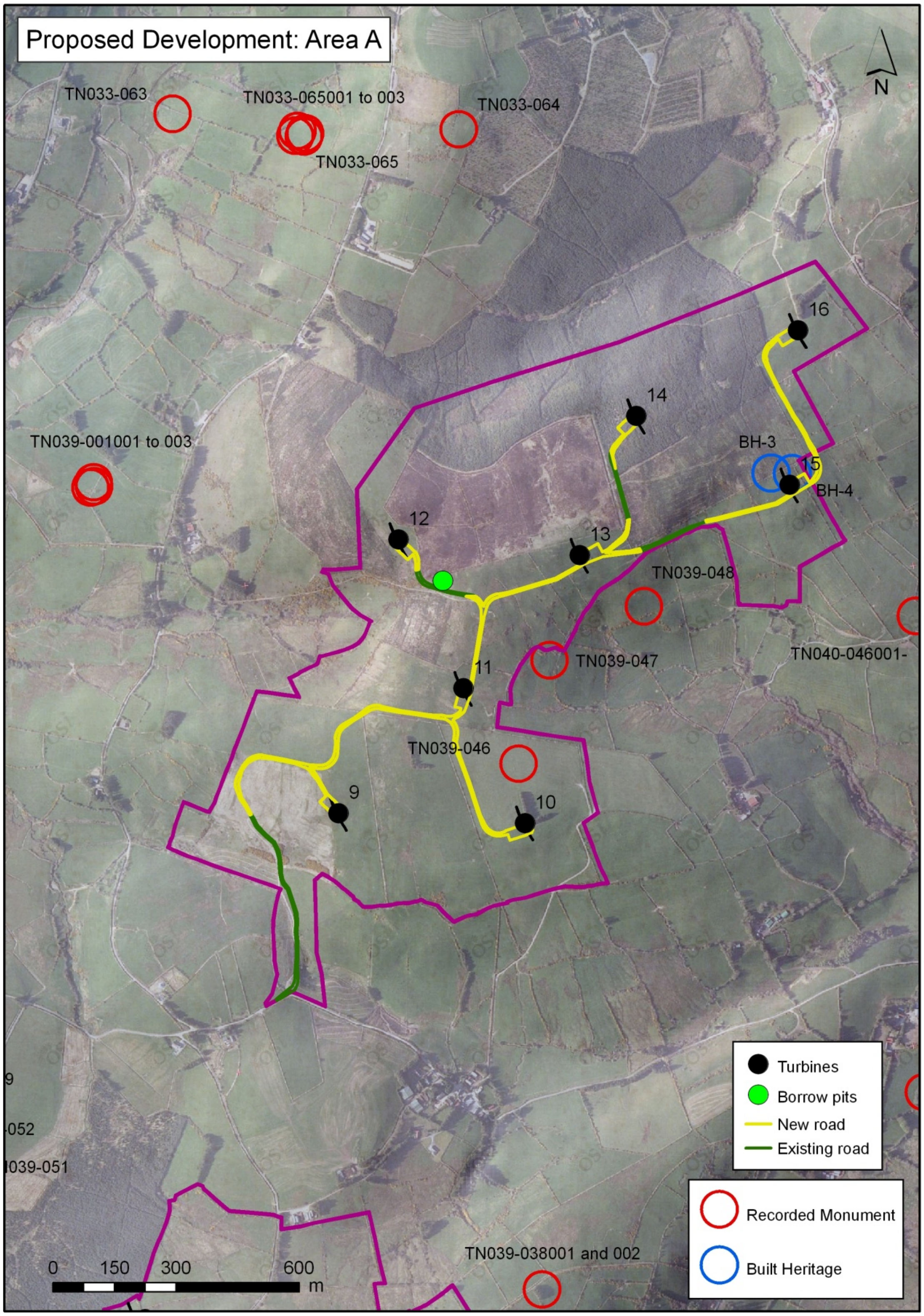


FIGURE 12-6: PROPOSED DEVELOPMENT (AREA A) AND SURROUNDING ENVIRONMENT ON OSI ORTHOPHOTOGRAPH (2005)

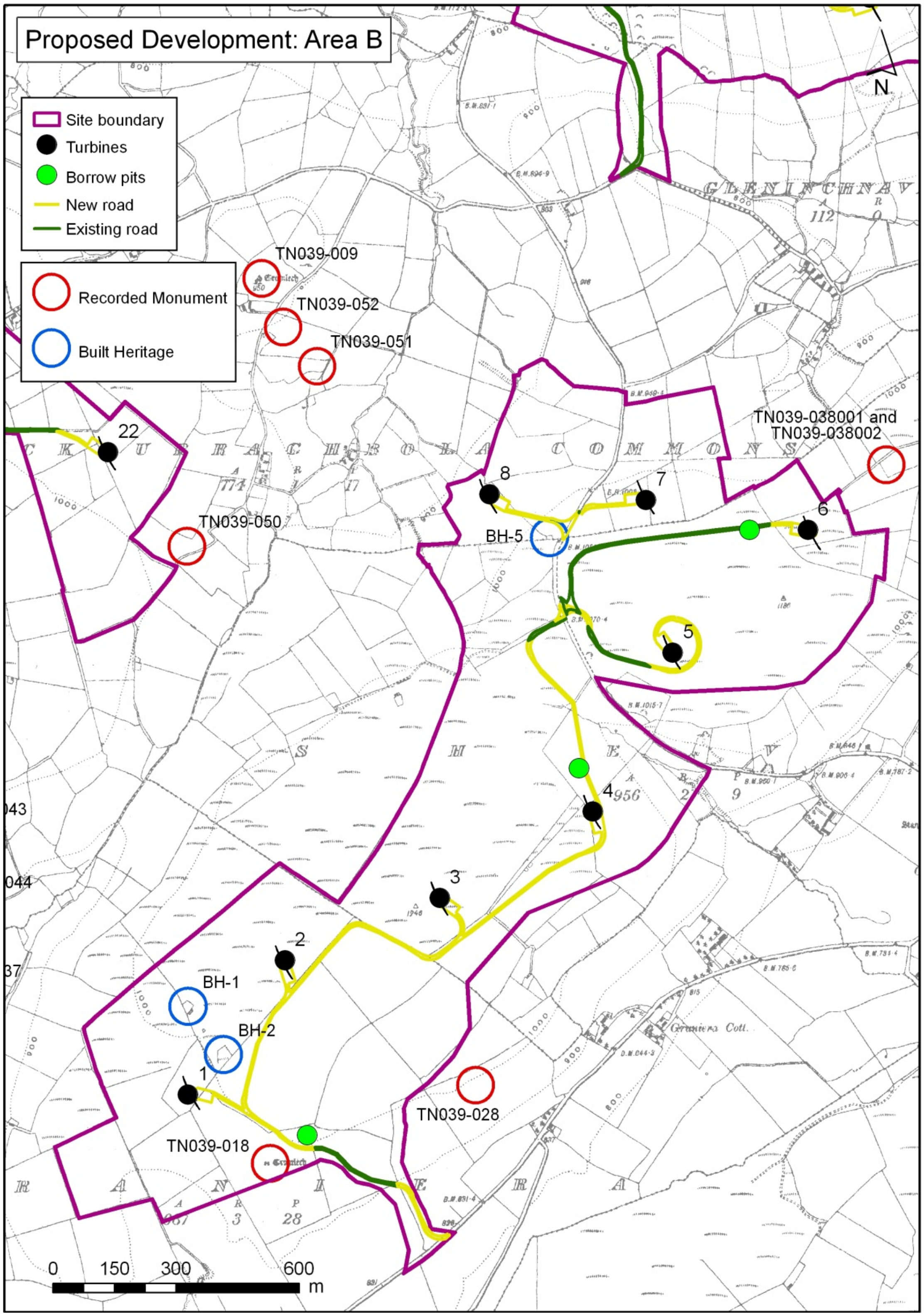


FIGURE 12-7: PROPOSED DEVELOPMENT (AREA B) AND SURROUNDING ENVIRONMENT ON 1905 2ND EDITION OS MAP

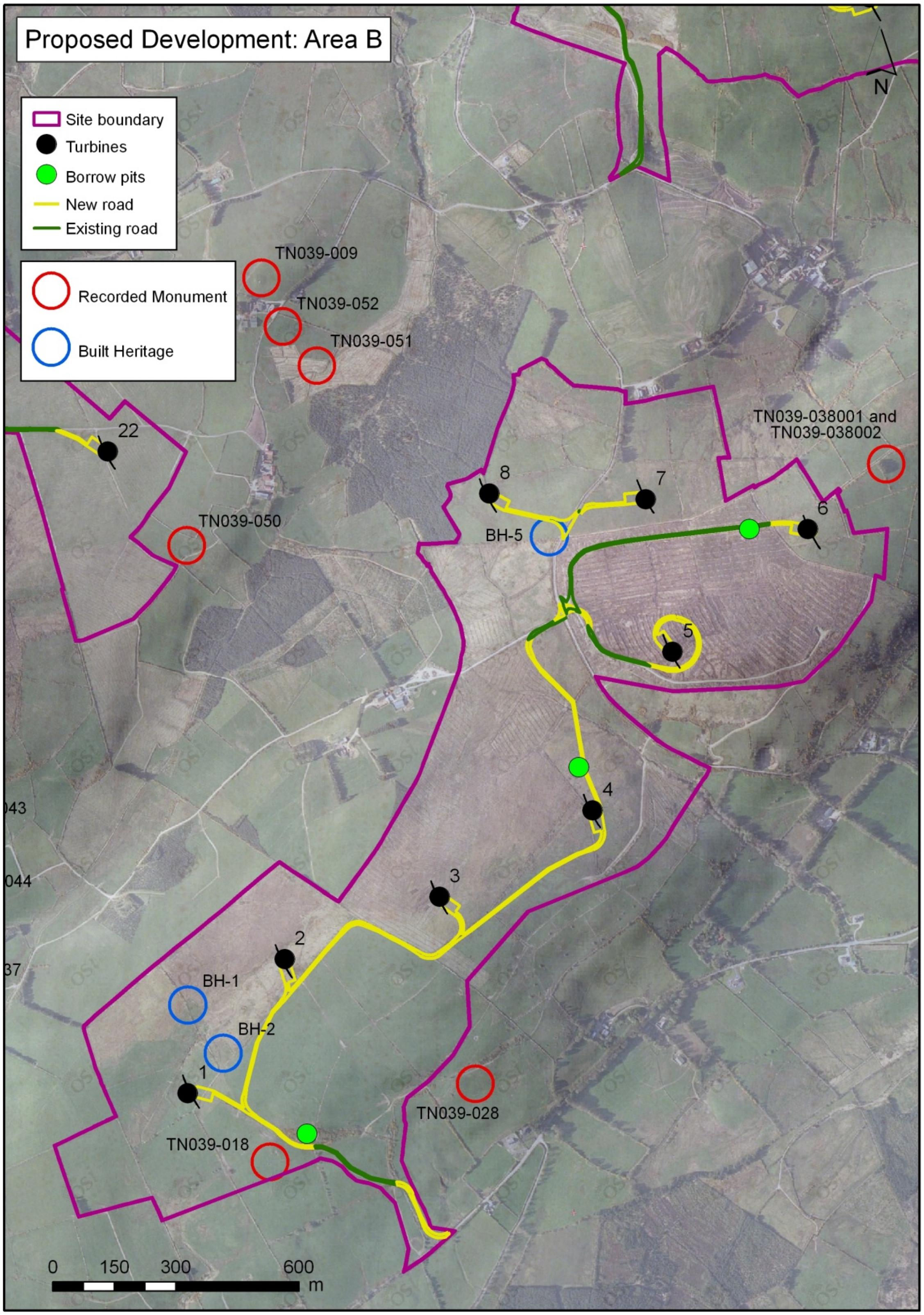


FIGURE 12-6 PROPOSED DEVELOPMENT (AREA B) AND SURROUNDING ENVIRONMENT ON OSI ORTHOPHOTOGRAPH (2005)

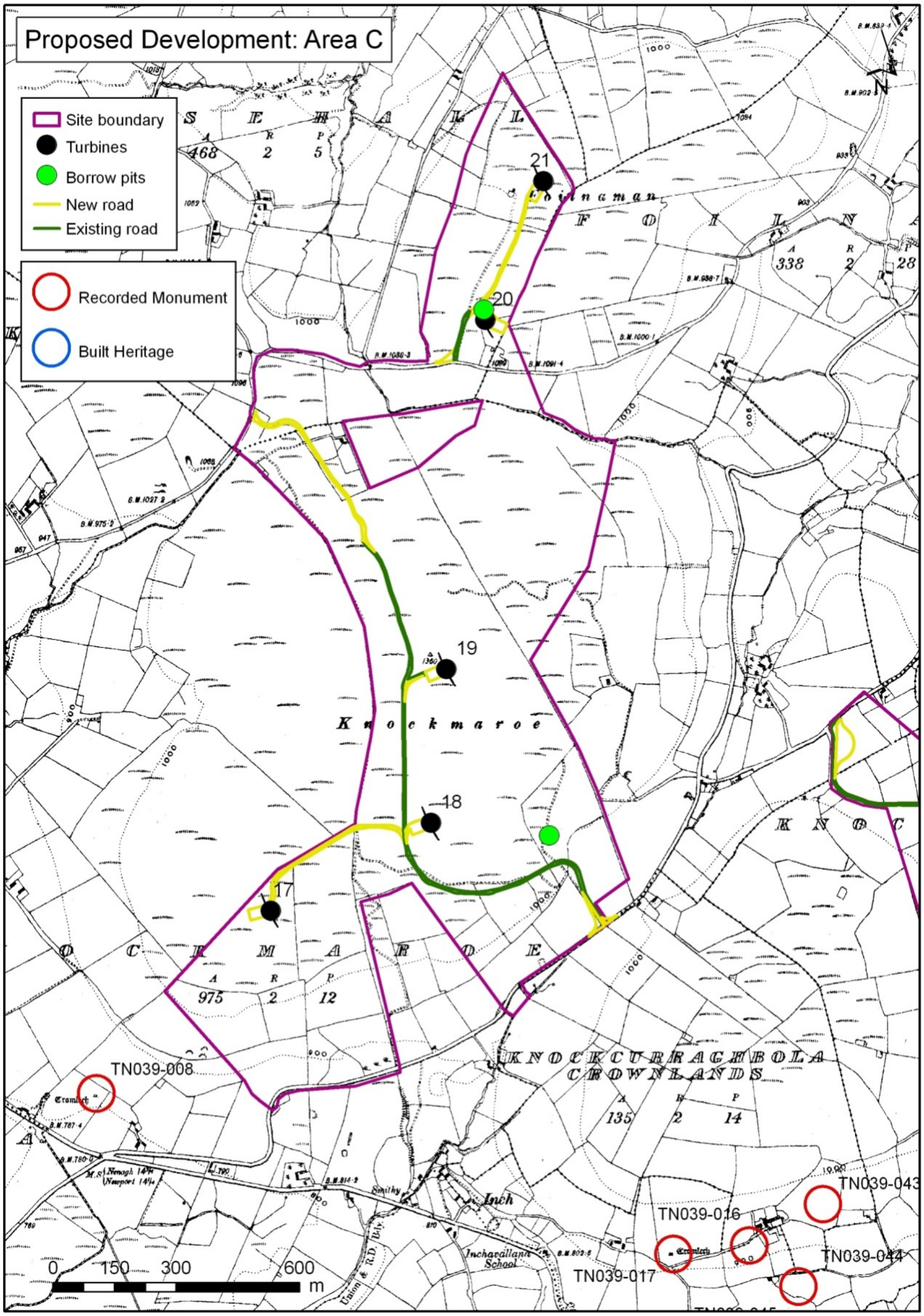


FIGURE 12-9: PROPOSED DEVELOPMENT (AREA C) AND SURROUNDING ENVIRONMENT ON 1905 2ND EDITION OS MAP

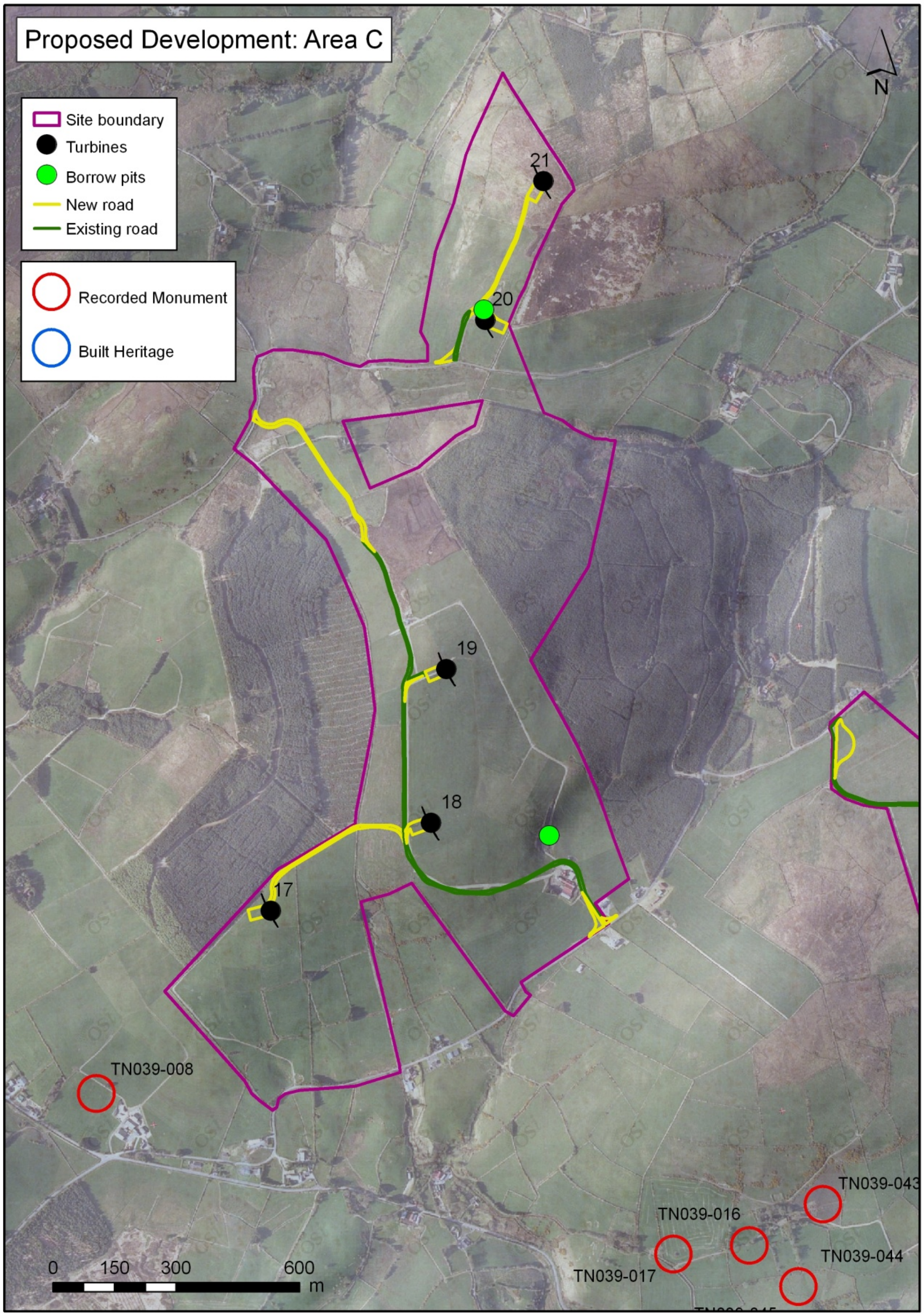


FIGURE 12-10: PROPOSED DEVELOPMENT (AREA C) AND SURROUNDING ENVIRONMENT ON OSI ORTHOPHOTOGRAPH (2005)

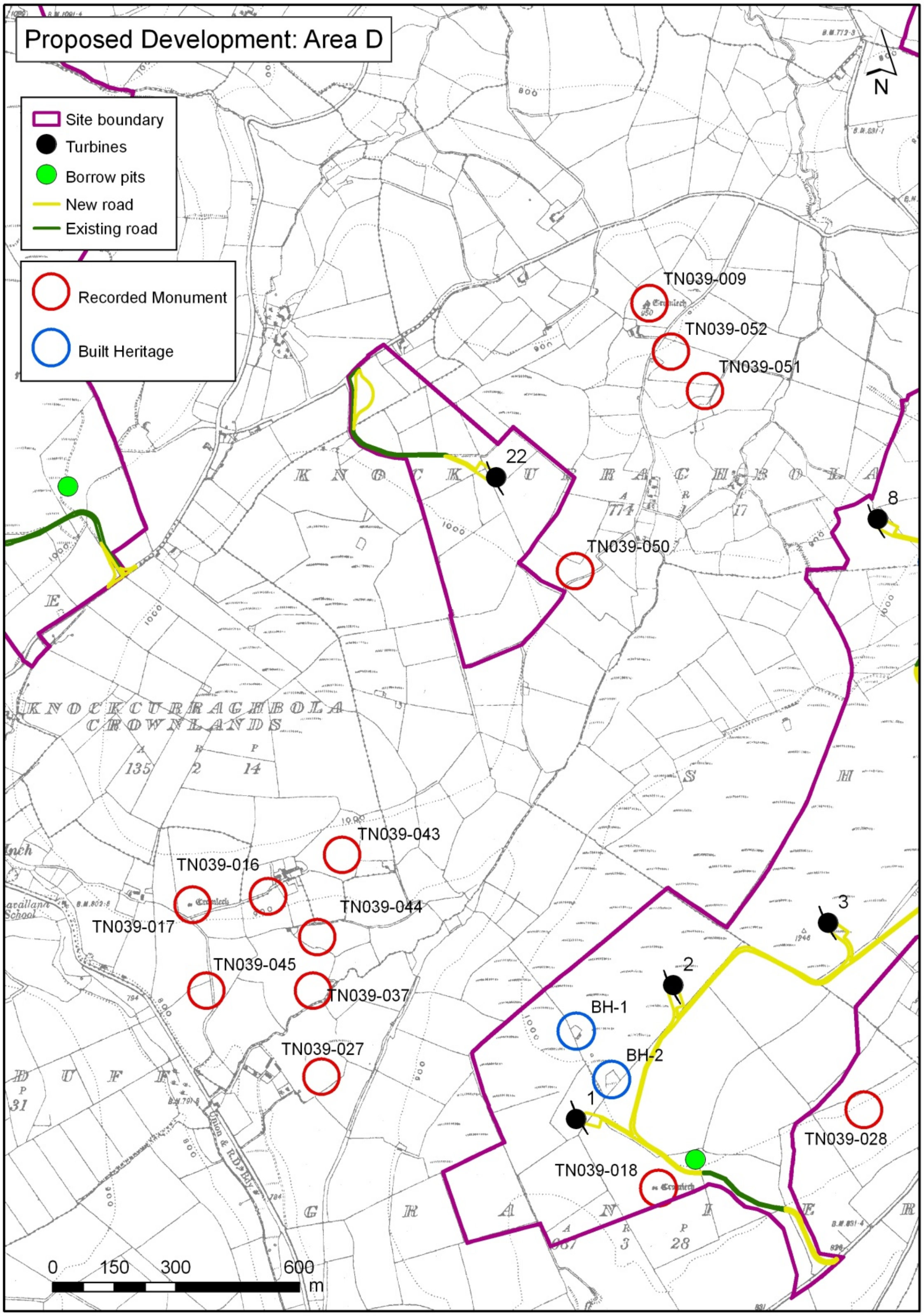


FIGURE [illegible] PROPOSED DEVELOPMENT (AREA D) AND SURROUNDING ENVIRONMENT ON 1905 2ND EDITION OS MAP

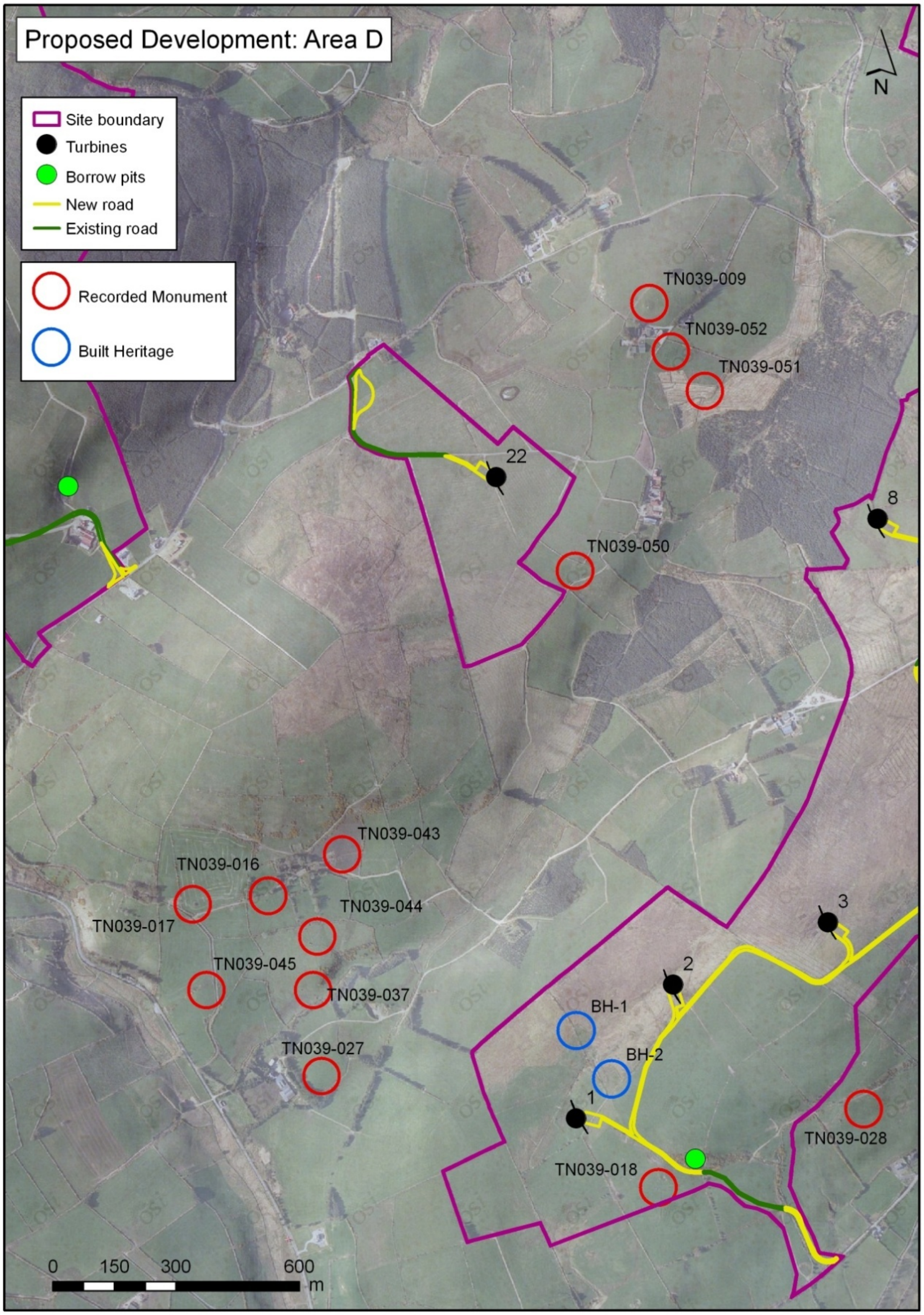


FIGURE 12-12: PROPOSED DEVELOPMENT (AREA D) AND SURROUNDING ENVIRONMENT ON OSI ORTHOPHOTOGRAPH (2005)

12.2.2 Results of field survey

The field inspection of the proposed development area and its immediate environs was undertaken over three days (18^{th} May, 21^{st} May and 22^{nd} May 2012). The weather was inclement on the first day and overcast with occasional sunny spells on the second and third days. A description of the fields visited in each of Areas A-D follows. A photograph of each field is presented in Appendix 12-III and of each turbine location in Appendix 12-IV. A summary table appears at the end of this section (Table 12.4)

AREA A

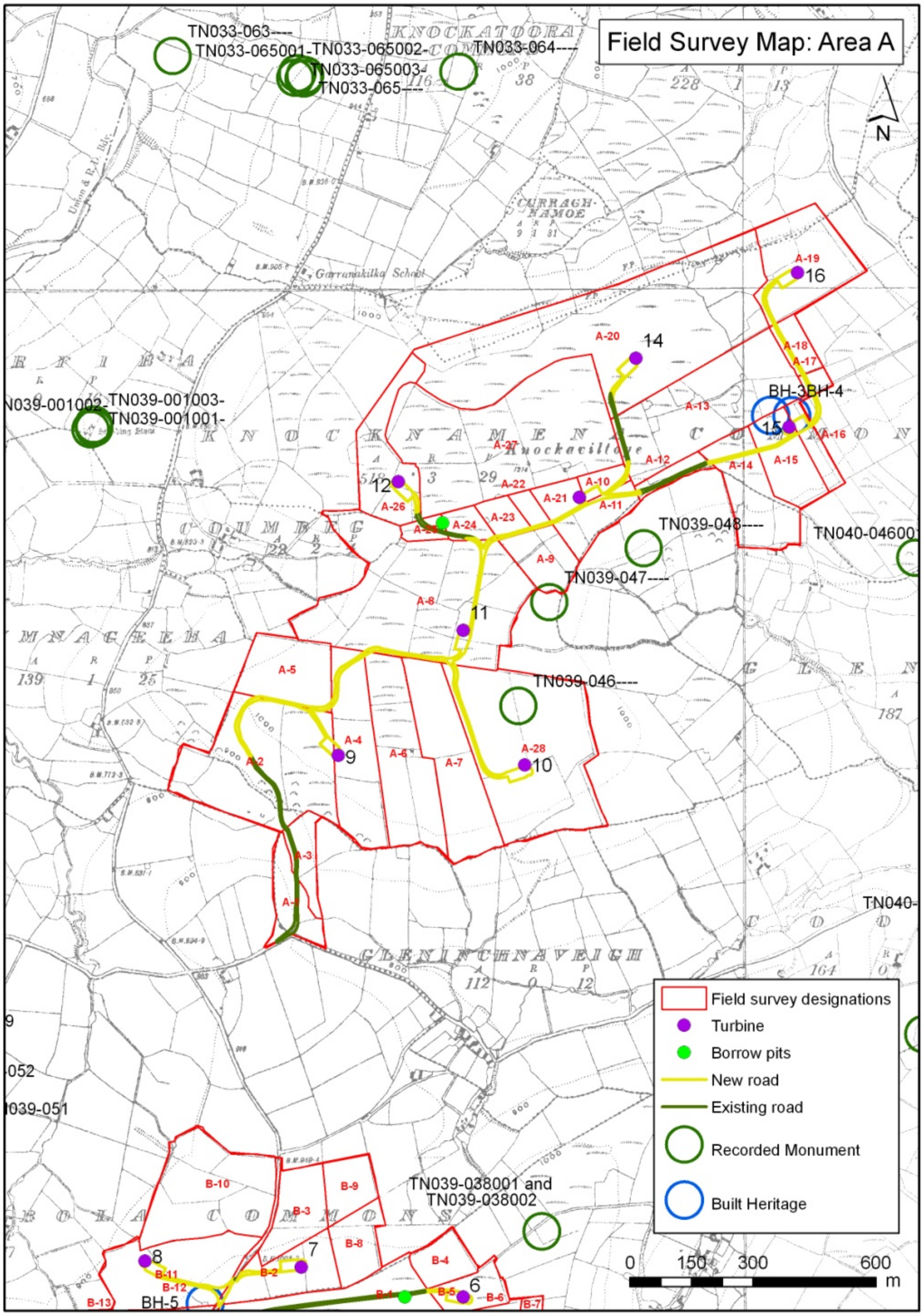


FIGURE 12-13: FIELD NUMBERS AND BOUNDARIES FOR AREA A OF THE PROPOSED DEVELOPMENT

Field A-1
Access Rd
Gate entrance from road to Area A. Gate at S of field. Small stone agricultural building near gate. This building is not visible on the 1st edition OS map. Track runs S-N. Rest of field under young forestry, divided by post and wire fencing. Slopes W-E. No archaeological features visible at the time of the inspection.

Field A-2
Access Rd
Large field covered by a mixture of young forestry and gorse. Moderate slope from NE-SW. Track continues in a SE-NW direction before turning to the right at the top of the field and running along the N boundry. Surrounded by wire and post fencing. This is the proposed route for the haul road. No archaeological features visible at the time of the inspection.

Field A-3
Access Rd
Large Pasture field. Surrounded by wire and post fencing. Moderate N-S facing slope with gentle undulations. No archaeological features visible the time of the inspection.

Field A-4
Access Rd
Turbine 9
Large undulating pasture field. Slopes N-S with a gentle E-W slope at the N end of the field. This is the proposed site of Turbine 9. Patches of boggy ground with reed growth scattered about field. Haul road runs along north boundry of the field. No features of archaeological potential noted.

Field A-5
Access Rd
Undulating pasture field. Gentle SE-NW slope. Surrounded by wire and post fencing. No features of archaeological potential noted.

Field A-6
Access Rd
Possible mound
Mixture of pasture and marshy land. Scattered reeds at north end of field. Slopes N-S with gentle undulations. Possible mound at north end of field. Sits on high ground with good panoramic views in all directions. Roughly oval in shape, sixed 17m from E-W and 25m N-S. Rises to approximately 1.5m high. Not visible on the 1st edition OS maps. Proposed haul road runs along the N boundry of this field and passes close to this mound.

Field A-7
Possible mound
Large field of pasture. Good visibility. Declines NW-SE. Bounded by post and wire fencing. Haul road runs along N boundry. L shaped tree formation and NW boundry. At N there is a pile of stones about 6m E-W and 5m N-S. Roughly 1M in height. Possible field clearance. No record on 1st edition OS map.

Field A-8
Turbine 11
Access Rd
Marshy ground covered in reeds with panoramic views in all directions. Slopes steeply E-W. Field subdivided at lower western side. Proposed site of Turbine 11. Ringfort T039-047 lies just to the E of the field, outside the proposed development area. Bounded by a low earthen bank on all E, W and S sides. Young forestry along the N boundry. Proposed haul road bisects the field N-S.

Field A-9
Field covered in young forestry. Very gentle south facing slope. Forestry meant visibility was very poor.

Field A-10
Turbine 13
Access Rd
Site of Turbine 13. Slopes gently to S. Small pasture fields. Bounded by earth and stone banks roughly 1m high by 1m wide. Proposed haul road will run over these boundries. No features of archaeological potential noted.

Field A-11
Access Rd
Gentle S sloping, undulating field posibly used as pasture. Scatterings of stone and surrounded by earth and stone boundry. Some evidence of old boundry walls. Proposed haul road will cross over the north boundry and run along the north of the field. No features of archaeological potential noted.

Field A-12
Access Rd
Narrow strip of pasture with forestry along the northern boundry. E and W boundries are a 1m high earthen bank. Haul road runs W-E and will bass through these boundries. No features of archaeological potential noted.

Field A-13
Access Rd
Field is covered in medium aged forestry. Visibility is poor and forestry made the field impossible to visit. Slopes gently W-E. Proposed haul road runs N along with the E boundry. No features of archaeological potential noted.

Field A-14
Access Rd
This field contains mixture of pasture land to the north and reedy marsh land to the south. Rounded by earth and stone boundries about 1m high by 1m wide. Small quarry is visible in the N of the field facing S. Field slopes N-S with gentle undulations. Haul road runs E-W along north end of the field and will cross over the above mentioned field boundries. No features of archaeological potential noted.

Field A-15
Turbine 15
Access Rd
Undulating pasture field with general NW-SE facing slope. Occasional rocky outcrops throughout field. Bounded by a 1m high by 1m wide bank. Haul road runs along N boundry of the field and will cross these boundries. Contains the proposed site for Turbine 15. Turbine site is in the NE end of the field. Field also contains evidence of a C-shaped enclosure on the N boundry of the field. This consists of stone and earth walls 1.5m wide by .75m high. This is situated approx. 30 M from the E boundry of the field and is quite close to the proposed site of the turbine and the haulroad servicing it. The enclosure is visible on the 1st edition OS map.

Field A-16
Narrow strip of pasture field. Boundries are earthen banks, .75m high by 1.5m wide and are mostly covered in gorse. Field slopes NW-SE. Contains an enclosure which abuts the W boundry of the field and is rectangular in shape. Its dimensions are 18m by 10m. The walls dimensions are similar to the field boundries. There is a slightly raised section(approx .50m) in the middle of the enslosure. It is not visible on the 1st edition OS map.

Field A-17
Access road
Small pasture field. Poor grazing land sloping gently to the E. Boundries are covered in gorse. Haul road cuts across NW corner of field and will pass through the boundries. No features of archaeological potential noted.

Field A-18
Access road
Moderate to poor pasture land in use for grazing. Gently undulating with a gentle slope SW-NE. Boundries are earthen and roughly 1m high by 1m wide. North of field is very boggy. Pond on N boundry. Haul road runs along W boundry of the field and passes though the boggy land as it crosses the north boundry. No features of archaeological potential noted.

Field A-19
Turbine 16
Access road
Proposed site of turbine 16. Undulating pasture with a mixture of grazing land and marshy wetland. Scatteded reeds. Slopes from W-E and bisected from N-S by a low boundry. There is a large natural hollow on the north end of the field. Proposed haul road runs along the SW boundry until turning to the E to the turbine site. No features of archaeological potential noted.

Field A-20
Turbine 14
Access road
Field covered in old forestry. Unable to visit. Contains proposed site for Turbine 14. Field is on a steep S-N slope. No features of archaeological potential noted.

Field A-21
Access road
Slopes gently NW-SE with heavy undulations. Pastureland with scattered rocky outcrops and marshy wet land patches. Contains a modern concrete structure which cannot be defined but appears to be unused. Field is bounded by a 1m high and 1.5m wide earth and stone bank. Haul road runs roughly E-W, crosses the S bank and runs along the S boundry No features of archaeological potential noted.

Field A-22
Access road
Poor pasture with marshy patches as well as occasional rocky outcrops. Undulates heavily with a gentle S facing slope. There is a vertical exposure of bedrock in the NE corner that may be a quarry. Field is bounded by a 1m high and 1.5m wide earth and stone bank. Haul road runs E-W crossing these boundries. No features of archaeological potential noted.

Field A-23
Access road
Marshy land with heavy reed covering. Undulates heavily with a gentle S facing slope. N, E and S boundries consist of earth and stone banks approximately 1m high and 1.5m wide. W boundry defined by forest from field A-9. Proposed haul road runs E-W SW quadrant as a small mound of stones. Not obvious of this is of archaeological interest as it may be part of a field clearance or an old field boundry. Mound is 11m N-S, 8m E-W and 1.5m high. Not visible on the 1st edition OS maps.

Field A-24
Access road
Rocky exposed ground. Trackway runs along E-W and will be part of the proposed haul road. Steep slope runs N-S. Forestry along S boundry. No features of archaeological potential noted.

Field A-25
Access road
Rocky exposed ground with patches of gorse. Trackway runs along E-W before turning N and will be part of the proposed haul road. Steep slope runs N-S. Forestry along S boundry. No features of archaeological potential noted.

Field A-26
Turbine 12
Access road
Poor pasture land with a moderate NE-SW slope. Proposed site of Turbine 12. Commanding views of surrounding contryside. Old forestry on the W boundry of the field. No features of archaeological potential noted.

Field A-27
Access road
Large field consisting entirely of gorse and reeds. Steep S-N slope. Proposed alternative haul road runs E-W though this field. Visibility poor. No features of archaeological potential noted.

Field A-28
Turbine 12
Access road
TN039-046
Large field level at N with a gentle N-S slope developing to the S. Contains monument TN039-046, however this monument is much degraded and was not visible on the day the field was visited. Field surrounded and subdivided by wire and post fencing. Haul road runs south along the W boundary before turning E to the proposed site of Turbine 20

AREA B

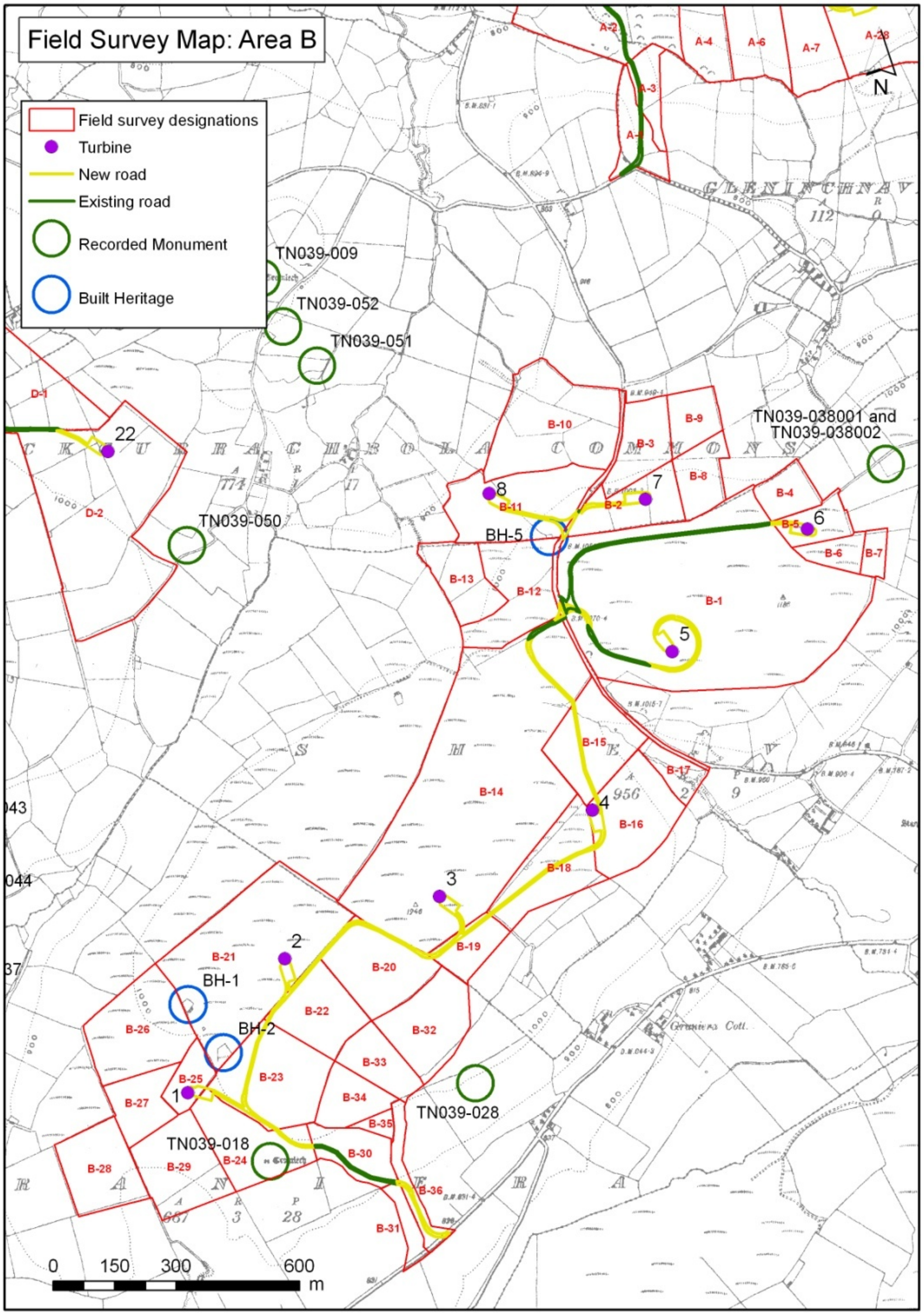


FIGURE 12-14: FIELD NUMBERS AND BOUNDARIES FOR AREA B OF THE PROPOSED DEVELOPMENT

Field B-1
Turbine 5
Access road
Large field covered in young forest. Contains the peak of a hill and slopes down on each side. Difficult to see ground as it is covered in trees, branches and tree stumps. Existing wind turbines visible to SW. Commanding vies of surrounding landscape. Proposed site of Turbine 5. Road runs along the W boundry of the field. Existing track enters field from this road way and runs along the N end of the field and exiting on the E boundry. This is the route of the propsed haul road. This route branches to the south in the middle of the field to reach the site of turbine 5. Nothing of archaeological potential noted.

Field B-2
Turbine 7
Access road
Pasture with forestry on the S boundry. S-N slope, leveling out at the N end of the field. Wide ditch on the E boundry. Proposed turbine 7 site centrally situated with the haul road entering the field from the W. No features of archaeological potential noted.

Field B-3
N-S slope reaching the base of a valley at the S end. Surrounded by earth and stone boundry measuring 1m high by 1.5m wide. Farm building to the N outside proposed development area. No features of archaeological potential noted.

Field B-4
Poor pasture with rushes scatted throughout the field, interspersed with occasional small trees. Earthen bank on 4 sides roughly 1m high and wide. Slopes S-N steeply. No features of archaeological potential noted.

Field B-5
Turbine 6
Access Rd
Marshy land with a large covering of rushes. Earthen bank on 4 sides roughly 1m high and wide. Moderate to sharp slope S-N. Site of turbine 6. Haul road will cross the W boundry bank to access the proposed turbine location. No features of archaeological potential noted.

Field B-6
Pasture with scattered clumps of reeds. Slopes gently S-N. Earthen bank on 4 sides roughly 1m high and wide. No features of archaeological potential noted.

Field B-7
Large pasture. Development area does not cover the entirety of the field. East facing slope. Gravel pit on S end of the field. Earthen bank on 4 sides roughly 1m high and wide. No features of archaeological potential noted.

Field B-8
Gently S-N sloping pasture field. Scattered stones to the N. Forestry on the S boundry. All sides have a modern deep boundry, roughly 2.5m. No features of archaeological potential noted.

Field B-9
N-S slope reaching the base of a valley at the S end. Surrounded by earth and stone boundry measuring 1m high by 1.5m wide. Cluster of trees at the south boundry of the field. No features of archaeological potential noted.

Field B-10
Cluster of lowlying fields. Mainly wetland with patches of pasture scattered around. Occasional evidence of old boundry walls however few are intact. Difficult to reach so not systematically walked. Entirety of field was visible and no features of archaeological potential noted.

Field B-11
Turbine 8
Access road
SE-NW facing slope. A sharp ridge runs from the S to the NE boundry and north of this the gradient steepens. Several artificial undulations are visible through out the field which be old field boundries. N of field on a vally floor and is extremely wet and boggy. This is the proposed site for turbine 8. The proposed haul road runs from the SE corner of the field down hill to the site of the turbine. A drainage ditch runs along the N boundry and forestry runs along the W boundry. No features of archaeological potential noted.

Field B-12
Pasture with occasional clumps of reeds and wetland. Slopes steeply S-N and surrounded by a 1.5m deep ditch. Road runs along the W boundry. No features of archaeological potential noted.

Field B-13
Field covered in young forestry. Visibility poor. Gentle SE-NW slope. No features of archaeological potential noted.

Field B-14
Turbine 3
Access road
Large field sloping steeply SW-NE. Very poor marsh land. Old forestry to S and W. Haul road cuts acrss the NE edge of the field reenters the field in the SE, accessing the propsed

site for turbine 3. This site is on the peak of the hill and commanded excellent views of the the surrounding landscape. No features of archaeological potential noted.

Field B-15

Steep S-N slope. Poor, rushy wetland. Deep ditch runs E-W along N edge of the field. 1m high by 1.5m wide earthen banks along the SW and NW boundries. Proposed haul road runs from the NW to SE of the field and crosses these boundries. No features of archaeological potential noted.

Field B-16

Turbine 4

Access road

Steep SW-NE slope. Reedy covered marchy land. Proposed site of turbine 4 is in the W corner of the field. Surrounded by 1m high and 1.5m wide earthen boundries. Haul road enters in next to the turbine site and exits to the SW. This will go through these exisiting boundries. No features of archaeological potential noted.

Field B-17

Boggy gorse covered field with S-N slope. A stream runs E-W. 1m high and wide boundries on 4 sides with a road runing along the N boundry. No features of archaeological potential noted.

Field B-18

Access road

Gorse covered wetland sloping SW-NE. Surrounded by bank 1m high and 1m wide. Haul road enters the field in the NE and runs straight through to exit on the SW. This cuts through boundries at both the entry and exit points. No features of archaeological potential noted.

Field B-19

Access road

Mixture of pasture and marshy wetland. 1m high and wide bank along the N, W and E sides of the field. Thin strip of young foresty along the SW boundry. Hall road runs NE to SW and will cut through one earthen boundry and the forestry No features of archaeological potential noted.

Field B-20

Access road

Large field of good pasture land. Undulates strangelyat the SW end where it looks terraced but is natural. Earthen bank to the S, N and E up to 1.2m high. W boundry defined by a wire and post fence. Proposed haul road to run along E and N boundries. No features of archaeological potential noted.

Field B-21
Turbine 2
Access road
BH-1 and BH-2 : Possible booleys
Large wetland field sloping steeply E-W. Covered thickly in reeds. Proposed site of turbine 2. Test pit however has been dug in the adjoining field. Haul road enters from the S beside wither the proposed turnbine site is located. Surrounded by an earthen bank roughly 1m high and 1m wide. Possible booley in SW corner of field (35m x 22m) and second one 150m to N (30m x 21m) W. Walls of this booley are 1m high and .5m wide. This is visible on the 1st edition OS map. No other features of archaeological potential noted.

Field B-22
Access road
Good pasture land with only occasional wet patches. NE to SW slope. Compacted undulations in the NE of field. N and E boundry consists of a 1m high earthen bank. S and W boundries consist of wire and post fencing. Proposes hall road runs long the N boundry. Turbines from a neighbouring windfarm run visible to the SW. No features of archaeological potential were noted.

Field B-23
Access Rd
Gently undulating NE-SW slope. Good pasture land with 1m high earthen boundries at the N, S and W ends of the field. Wire and post fencing defines the E side. A shallow drainage ditch runs along the N boundry of the field. Proposed haul roads run along the W and N boundries. No features of archaeological potential noted.

Field B-24
Access Rd
TN039-018
Good pasture land with a gentle NE-SW facing slope. Mild undulations across the field. Haul road runs across the NE corner of the field and will cross over the 1m high earthen boundries with run along all the edges of the field. There is a potential megalithic tomb in the centre of the field with NMS of TN039-018----. Description of this is in the monument table attached.

Field B-25
Access road
Turbine 1
Small pasture field with a E-W facing slope. Surrounded on all sides by a .8m high earthen bank. Soil is quite peaty and a stream runs along the N boundry. Site of turbine 1 is in the centre of the field and is accessed by a haul road entering the field from the E. No features of archaeological potential noted.

Field B-26
Field is split between marshy, reed covered land to the N and good pasture to the S. Surrounded by a 1m high eathern bank on all sides. Slopes generally N-S. No features of archaeological potential noted.

Field B-27
Good pasture land with a N-S facing slope and gentle undulations. Surrounded by a 1m high eathern bank on all sides. No features of archaeological potential noted.

Field B-28
Good pasture land with a gentle W-E slope. There is a clump of trees in the SW and the grass is long beneath the same. A curve of reeds is visible in the SE and a drainage ditch runs E-W along the S part of the field. No features of archaeological potential noted.

Field B-29
Good pasture land with NE-SW facing slope. Stream runs along SW boundry. Surrounded by a 1m high eathern bank on all sides. No features of archaeological potential noted.

Field B-30
Access road
Good undulating pasture land with a general NE-SW slope. Banked by trees to the N. A large quarry can be seen in the NW corner of the field. The rest of the field is defined by wire and post fencing. Proposed haul road runs from NW to SE corners of the field. No features of archaeological potential noted.

Field B-31
Access road
Undulating pasture leading to the main road way to the south. Haul road runs N-S to the main road. No features of archaeological potential noted.

Field B-32
Moderate NE-SW sloping pasture field with some reeds visible. Low ditch and bank on W and N sides adjacent to new line of pine hedging. No features of archaeological potential noted.

Field B-33
Large field of good short pasture. Field slopes moderately N-S in northern half becoming steep in the southern half. Bordered by post and wire fencing. No features of archaeological potential noted.

Field B-34
As per field B-33 (adjacent field). No features of archaeological potential noted.

Field B-35
Triangular shaped N-S sloping pasture field. Bordered to the east by a 1m high bank. No features of archaeological potential noted.

Field B-36
Steep N-S facing pasture field. Slope moderates as it approaches road. Rich pasture with a boundry 1.2m high. Field half within site area. No features of archaeological potential noted.

AREA C

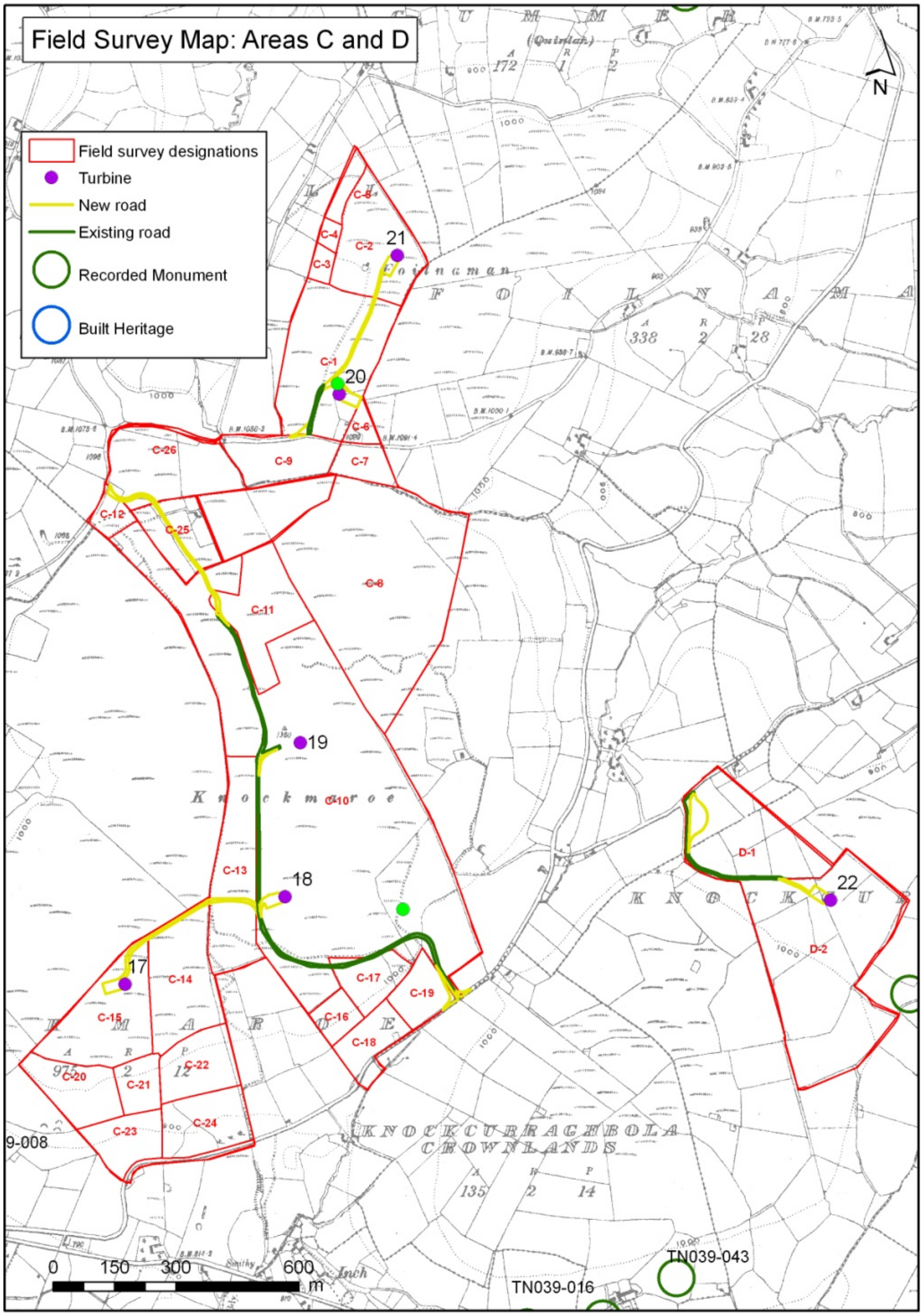


FIGURE 12-15: FIELD NUMBERS AND BOUNDARIES FOR AREAS C AND D OF THE PROPOSED DEVELOPMENT

Field C-1
Turbine 20
Access road
Pasture land with undulations and a gentle N-S and W-E facing slopes. Some reads along W boundry. Bisected N-S by an existing road which will form the basis of the proposed haul road. Turbine 20 is centrally located within the field and is situated on a spot with commanding views of the surrounding landscape. There is a quarry in the SE quadrant of the field. There is a road along the south boundry with a contrete gateway into the field. It is bound on 4 sides by a 1.5m high earth and grass bank. The haul road will cross over the N boundry. Field also contains an indeterminate artificial mound which is currently under long grass. This is probably an agricultural feature. No other features of archaeological potential noted.

Field C-2
Turbine 21
Access Road
Gorse and reed cover land with a SE-NW facing slope. The SE area of the field is quite boggy. Ground improves to good pasture land as you go down hill. Bound on all sides by stone and earth bank 1m high and 1.5m wide. Impressive all around view. Proposed haul road crosses the S boundry and approaches the site of turbine 21 which is located on a very steep slope. Possible mound at the left side of the hill 1m high and about 2m square. Stones are stood on their sides. No evidence of it being an archaeological feature on the 1st edition OS maps or the NMS. No other features of archaeological potential noted.

Field C-3
Pasture land with a moderate SE-NW slope. Surrounded by a 1m high and 1m wide earth and stone bank. No features of archaeological potential noted.

Field C-4
Pasture land with a moderate SE-NW slope. Surrounded by a 1m high and 1m wide earth and stone bank. Evidence of a stone wall on the along the N boundry approximately 1m high and 1.5m wide. No features of archaeological potential noted.

Field C-5
Very rocky pasture land with a SE-NW slope. Surrounded on 4 sides by a stone wall boundry approximately 1m high by 1.5m wide. No features of archaeological potential noted.

Field C-6
Small trangular shaped field of pasture land with a gentle NE-SW slope. Surrounded by a 1.75m high ditch and a round runs along its S boundry. No features of archaeological potential noted.

Field C-7
Good pasture field covered in long grass on little or no slope. It is bisected by a wire and post fence running E-W. A 1m deep gully runs along the W boundry. A 2m high bank

runs along the N boundry. Forestry from field C-8 defines the S boundry. No features of archaeological potential noted.

Field C-8

This large field is completely covered in old forestry. It lies on a moderate SW-NE slope. Visibility is poor. No features of archaeological potential noted.

Field C-9

Field of pastureland with gentle undulations. It is bisected E-W by wire and post fencing. Patches of marshy ground are scattered across the field. A deep ditch runs along the N boundry. No features of archaeological potential noted.

Field C-10

Turbine 18

Turbine 19

Access Rd

Large lush pasture land rising to the peak of the hill it is situated on. Slopes mainly from N-S however slopes in all other directions from the peak. The field is subdivided by wire and post fencing. Forestry runs along its E and W boundries. A quarry is visible in the SE of the field next to a collection of modern farm buildings. The haul road enters the field in the SE and runs along the south boundry before turning N for the length of the field, branching off at the location of the two turbines. There is an existing farm track that the haul road is proposed to follow. There is a communications tower also at the highest point of the field. As this is the highest point in the development area it affords excellent views of the surrounding landscape, including areas A, B and D. There is a mound of stones at the N end of the field. Stones are large, up to 2m by 1m and the pile of stones itself covers an area of 5m by 5m. A similar pile of stones in the corner of the field is most likely a field clearance. No other features of archaeological potential noted.

Field C-11

Marshy bogland covered in reeds. Bog is raised to the height of 1m. S-N facing slope. There is a ditch running E-W across the field which turns into a ridge and the incline steepens. No features of archaeological potential noted.

Field C-12

Small field of good pastureland with a S-N slope. A ditch and post and wire fence runs along the SE boundry. Forestry defines the SW boundry. To the NW there is a road with a gate way into the fiel. No features of archaeological potential noted.

Field C-13

Access road

Marshy wetland covered in reeds with a N-S facing slope. Bordered to the W by forestry and on the other three sides by wire and post fencing. A shallow ditch runs from E-W.

The boundry in the SW corner is a 1m high by 1m wide bank with wire and post fencing. The proposed haul road crosses the field E-W and will pass over this boundry. No features of archaeological potential noted.

Field C-14

Access road

Pasture field with a gentle N-S slope. There is a ridge running E-W across the fiel and S of this the slopes sharpens considerably. The field is bound on all sides by a 1m high and wide earthen bank with post and wire fencing. To the N is dense forestry. The proposed haul road enters the field in the NE and exits in the NW runing along the Norther boundry and crossing the existing banked boundries. No features of archaeological potential noted.

Field C-15

Turbine 17

Access road

Pasture with a gentle NE-SW facing slope. Bound to the N by thick forestry and on all other sides by a 1m high by 1m wide ditch. Proposed site of turbine 17 is in the NE corner of the field. No features of archaeological potential noted.

Field C-16

Rectangular pasture field with a N-S slope. Bordered to the south by a 1m high and wide ditch and on all other sides by wire and post fencing. No features of archaeological potential noted.

Field C-17

Pasture field with a N-S slope. Bordered to the south by a 1m high and wide ditch and on all other sides by wire and post fencing. No features of archaeological potential noted.

Field C-18 and C-19

Ploughed field with a gentle N-S slope. Bordered by a 2m high by 1.5m high bank. No feaures of archaeological potential visible.

Field C-20

N-S facing pasture surrounded by a 1m high and 1m wide bank. Clump of trees in the SE corner. Existing farm track runs from S to N. No features of archaeological potential noted.

Field C-21 and C-22

N-S facing pasture surrounded by a 1m high and 1m wide bank. No features of archaeological potential noted.

Field C-23

Pasture with a gentle N-S slope. Banked on all sides by a 1m high by 1m wide boundry. A gravel pit is evident in the SE quadrant of the field. An exisiting farm trackway runs from the N boundry to the S and through a gate onto the main road with runsalong the S boundry. No features of archaeological potential noted.

Field C-24
N-S facing pasture surrounded by a 1m high and 1m wide bank. Some trees in the SE corner. No features of archaeological potential noted.

Field C-25
Access road
Pasture with a moderate SE-NW slope. Ditched on the N boundry and fenced on the S. Access road runs N-S through this field. No features of archaeological potential noted.

Field C-26
Access road
Reed covereded boggy ground. Access road runs N-S through this field where it exits to the N onto the existing road. No features of archaeological potential noted.

AREA D

Field D-1
Access road
Area is completely covered in young forestry. Track runs N-S through middle of forest. Visibility very poor. Land is level. Haul road runs along S boundry. No feaures of archaeological potential noted.

Field D-2
Turbine 22
Access road
Area is completely covered in young forestry. Track runs N-S through middle of forest and is the proposed site of the haul road access to the turbine site. Visibility very poor. Land is level. Haul road runs along N boundry. No feaures of archaeological potential noted.

TABLE 12-4 SUMMARY OF TURBINE LOCATIONS VISITED IN FIELD SURVEY

Turbine Number	Field Number	Description
1	B-21	Small pasture field with a E-W facing slope.
2	B-21	Large wetland field sloping steeply E-W.
3	B-14	Steeply sloping marshy ground
4	B-16	Steeply sloping marshy ground
6	B-5	Sloped marshy land with a large covering of rushes.
7	B-2	Sloped pasture field
5	B-1	Large field covered in young forest.
18	C-10	Large lush pasture land rising to the peak of the hill it is situated on
19	C-10	Large lush pasture land rising to the peak of the hill it is situated on
21	C-2	Gorse and reed cover land with a SE-NW facing slope.
8	B-11	Steeply sloped marshy wetland.
10	A-28	Large level pastureland
9	A-4	Gently sloping pasture field
11	A-8	Steeply sloping marshy ground
12	A-26	Poor pasture land with a moderate NE-SW slope
13	A-10	Small gently sloping pasture field
15	A-15	Sloped pasture field
16	A-19	Undulating pasture with a mixture of grazing land and marshy wetland.
14	A-20	Field covered in old forestry
17	C-15	Pasture with a gentle NE-SW facing slope.
20	C-21	Pasture land with undulations and a gentle N-S and W-E facing slopes.
22	D-2	Level field completely covered in young forestry.

12.3 POTENTIAL IMPACT OF THE PROPOSAL

This section describes the potential impacts of the proposed scheme; these are summarised in Table 12.1.

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12.3.1 Construction Phase

*12.3.1.1 **Direct Impacts***

There will be no direct impacts on any cultural heritage sites, features or items. The possiblity exists however that previously unknown archaeological material could be impacted upon by the proposed development given the high number of Recorded Monuments in close proximity to development.

*12.3.1.2 **Indirect Impacts***

There will be no indirect impact on any of the recorded monuments in the study area.

There is the low potential for adverse indirect impacts on cultural heritage sites within the study area. The possiblity also exists that previously unknown archaeological/cultural heritage material could be impacted upon by the proposed development.

12.3.1.3 Interaction with Other Impacts

None were identified during the assessment.

12.3.2 Operational Phase

12.3.2.1 Direct Impacts

There will be no direct impacts on any cultural heritage sites, features or items during the operational phase.

12.3.2.2 Indirect Impacts

Eight out of 101 sites within the 4km study area will have intervisibilty with all 22 wind turbines. During the operational phase the development will lead to a visual impact upon the archaeological landscape.

12.4 REMEDIAL OR REDUCTIVE MEASURES

12.4.1 Construction Phase

12.4.1.1 Direct Impacts

Due to the possibility of the survival of sub-surface archaeological deposits or finds within the development area, it is recommended that all groundworks associated with the proposed development be archaeologically monitored under licence to the National Monuments Service.

12.4.1.2 Indirect Impacts

It is recommended that a buffer-zone where development is precluded, be instituted around the Recorded Monument in the proposed development area. This should measure a minimum of 30m around the site. In addition no site offices, depots or storage facilities should be placed within these buffer zone.

12.4.2 Operational Phase

12.4.2.1 Direct Impacts

As there will be no direct impacts on any cultural heritage sites, features or items during the operational phase no remedial or reductive measures are required.

12.4.2.2 Indirect Impacts

During the operational phase the development will lead to a visual impact upon the archaeological landscape. See visual and landscape assessment chapter for remedial/reductive measure.

12.5 MONITORING

Monitoring is discussed in section 12.4.1 above.

12.6 REINSTATEMENT

Any site requiring re-instatement will be established in conjunction with the statutory authorities.

12.7 BIBLIOGRAPHY

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EPA 2003 *Advice noted on current practice (in the preparation of Environmental Impact Statements),* EPA, Dublin.

Maps

First edition 1837 Ordnance Survey map sheet 69

Second edition 1920 Ordnance Survey map sheet 69

Griffiths's Valuation maps and valuation report

Records of Monuments and Places (RMP) constraints maps sheet 69

Aerial photographs

1995 Ordnance Survey orthophotography

2000 Ordnance Survey orthophotography

2005 Ordnance Survey orthophotography

2012 Google Earth

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APPENDIX 12-I

DESCRIPTION OF RMP SITES WITHIN STUDY AREA.

Table 1: Descriptions of Recorded Monuments within a 4km radius of proposed development. Table extracted from Archaeological Survey of Ireland database

SMRS	NAT_GRID_E	NAT_GRID_N	TLAND_NAME	CLASSDESC	Description
TN033-026----	194430	165750	DAWSONSBOG	Enclosure possible	Situated on level ground at the base of a SE-facing hillslope with a stream, which forms the townland boundary, running NE-SW c. 15m S of the site. Depicted on the 1st ed. (1840) OS 6-inch map as a roughly pear-shaped enclosure, which is semicircular from NE to S to SW and then straightens and tapers towards the townland boundary. It is only partially depicted on the 1902 ed. The site has been levelled but is still visible as a large irregular enclosure (dims. 44m N-S; 57m NW-SE) defined by a very low bank (Wth 2.7m; int. H 0.18m; ext. H 0.14m).
TN033-027----	194710	163350	GLASTRIGAN	Stone Row	Situated at the base of the N slope of a small hillock which in turn is on the SE-facing slope of a ridge in an upland area. Site indicated on 1st ed. (1840) OS 6-inch map as 'Three Stones'. Not depicted on subsequent 2nd (1902) ed. A row of four stones, aligned NE-SW, with a possible fifth stone (H 1.3m; Wth 0.45m; T 0.2m) lying prostate near a gap in the row; overall length 7.63m. These limestone orthostats are set in a slight hollow with little evidence of packing-stones, though there are tufts of grass around the bases. The largest standing stone (H 1.78m; 1.56m x 0.4m), at SW end, has a hole in the SE face into which hands were dipped as a cure for warts. From NE to SW the remaining three stones measure: (1) H 1.05m; 0.76m x c.0.3m (2) H 1.56m; 1.47m x 0.28m (3) H 0.95m; W 0.8m x 0.53m.

TN033-029001-	195250	165610	GREENAN	Castle - Ringwork possible	Situated at the base of a S-facing slope in an undulating valley with a stream c. 10m W of the site running N-S. A small hillock has been artificially scarped to create a large, trapezoidal, grass-covered platform (66m max. N-S; 29.5m min. N-S; 63m E-W) enclosed by a low, earth and gravel bank (Wth 1.3m; int. H 0.35m; ext. H 1.57m) which falls steeply to the exterior and is relatively insignificant internally. The bank is levelled at NE and the S end of the E side has been denuded by modern agriculture. There is no fosse visible around the base of the platform though there is a slight dip (Wth c. 1m) which is quite wet. A fulacht fia (TN033-029002) is incorporated into the NE angle of the site and another (TN033-029003) lies immediately N of the site.
TN033-029002-	195250	165610	GREENAN	Fulacht Fia	Situated at the base of a S-facing hill in an undulating valley with nearby fulacht fia (TN033-029003) to W. A mound of burnt material (dims. 5.3m NE-SW; 7.5m NW-SE; H 0.33m) incorporated into the NE angle of a possible ringwork (TN033-029001).
TN033-029003-	195250	165610	GREENAN	Fulacht Fia	Situated at the base of a S-facing hill in an undulating valley with nearby fulacht fia (TN033-029002) to E. Located immediately N of a possible ringwork (TN033-029001). A large horseshoe-shaped mound of burnt material (dims. 14.8m E-W; H above ext. 0.66m) with possible trough area at S (dims. 3.8m N-S; 2.8m E-W; H above possible trough 0.9m).
TN033-041001-	192300	164960	CLONTAAFFE	Standing Stone - Pair	Situated on a natural hillock in a valley, enclosed by high ground except to S. The immediate area is wet and rushy and has been planted with coniferous forest, as has the monument itself. The stone pair, composed of shaly limestone, is aligned on an NE-SW axis, with the larger stone (H 0.9m; L 1.6m; T 0.76m) to the SW and the smaller (H 0.82m; L 0.98m; T 0.13-0.25m) located 0.7m to the NE. The stones are roughly centrally placed within a kerbed enclosure (TN033-041002) which consists of a bank with internal and

					external stone revetment. Only the SE and SW portion of the bank survives.
TN033-041002-	192300	164960	COMMAUN BEG	Enclosure	Situated on a natural hillock in a valley, enclosed by high ground except to S. The immediate area is wet and rushy and has been planted with coniferous forest, as has the monument itself. The stone pair (TN033-041001), composed of shaly limestone, is aligned on an NE-SW axis, with the larger stone to the SW and the smaller located 0.7m to the NE. The stones are roughly centrally placed within a kerbed enclosure (diam. 10.7m E-W), which consists of a bank (Wth 1.4m; int. H 0.32m; ext. H 0.4m) with internal and external stone revetment. Only the SE and SW portion of the bank survives.
TN033-042----	192700	163940	CURREENY	Megalithic Structure possible	Situated on a gentle SE-facing slope in wet, upland terrain. A line of three closely set, upright stones orientated NE-SW. The largest, to the NE, measures 0.52m H (L 0.8m), the middle stone is 0.49m H (L 0.53m) and the SW stone is 0.62m H (L 0.45m). Approx. 5m to the SW there are four embedded stones arranged in pairs - possible double walling. This possible walling, running NW-SE, is 1.5m long and c. 0.7m wide. The largest stone is 0.37m high. The distance from the three uprights to the end of the walling is 6.3m. The landowner has dumped a number of boulders on and near the walling, these are loose. The possible remains of a much denuded tomb.

TN033-046----	194000	163020	GLASTRIGAN	Barrow - Mound Barrow possible	In flat poorly drained pasture on N side of the Clodiagh River in an upland region. The site consists of an irregular-shaped flat-topped earthen mound (H 2m; base dims. 20m NE-SW x 16m SE-NW) the top of which is defined by a scarp. The flat summit (diam. 12m NE-SW x 6m SE-NW) has a central depression (dims. D 0.3m; 1.7m x 1.3m) which may be an indication of a collapsed cist. Known locally as Quigley's fort.
TN033-051----	191320	165320	GORTAHUMMA	Barrow - Ring-Barrow possible	Situated on a S-facing slope of poorly drained ground in an upland region surrounded by modern coniferous plantation. A low poorly preserved irregular-shaped mound (Dims. 5m N-S; H 0.5m) enclosed by an inner fosse (Wth 2.2m; D 0.3m) and outer bank (Wth 1.5m; H 0.1m) visible at N only. The bank is intersected at N by a townland boundary extending NE-SW.
TN033-059----	196568	164312	CAPPANAVILLA	Fulacht Fia	Situated on wet poorly drained NW facing slope of rising ground in upland mountain valley overlooking valley to W. Higher ground to S and E. Roughly horseshoe shaped mound (H 0.5-0.8m; dims. 13.5m N-S; 9m E-W) of burnt material with slight depression (D 0.2m; 2m x 2m) in W face, facing onto old drain running N-S to W of fulacht.
TN033-060----	196570	164473	CAPPANAVILLA	Barrow - Ring-Barrow	Impressive well preserved ring-barrow situated on wet poorly drained grassland on N facing slope in upland area overlooking river valley below to W, higher ground to E. Well preserved monument consisting of a circular area (diam. 4.1m N-S; 4.1m E-W; H above fosse 0.6m) enclosed by an inner fosse (base Wth 1m; top Wth 1m; ext. D 0.5m) and outer bank (Top Wth. 1.8m; base Wth 1.8m; ext. H 0.5m). Gap in bank at NNW probably the result of livestock poaching, livestock gap. No other features visible. Site has good views looking down into mountain valley whch runs E-W . Overall diameter of monument 8.9m N-S x 9.8m E-W.

TN033-061----	196733	164125	CAPPANAVILLA	Barrow - Ring-Barrow possible	Situated in pasture on fairly level ground, in mountainous region with good panoramic views in all directions. Much degraded monument that is barely visible as a low circular rise of ground (diam. 11m SE-NW; 10m NE-SW) defined by a fosse (Wth 2m; ext. D 0.2m) with the slightest traces of an outer bank. Site is severely degraded and is only visible during the winter months.
TN033-062----	196427	164035	GARRANAKILKA	Fulacht Fia	Situated on poorly drained land with a stream immediately to the SE. Roughly crescent-shaped mound (max. H 1m; dims. 13m NW-SE; 10m NE-SW) of burnt material with slight shallow depression in S face of mound. This depression may indicate possible location of trough area.
TN033-063----	195701	163352	GARRANAKILKA	Barrow - Ring-Barrow	Situated on poorly drained W facing slope overlooking Clodiagh River in mountain valley. River runs through base of mountain valley from N to S. Higher ground overlooks barrow to E. Well preserved site consisting of a low oval-shaped sunken area (diam. 7.5m N-S) enclosed by a slight bank (Wth 3m; int. H 0.1m) and outer fosse (base Wth 2m; ext. D 0.2m). Overall diameter of site measures 21m N-S; 16m E-W. Not clear whether the sunken area in the centre is enclosed by a bank or is this just a bank created by the sunken interior.
TN033-064----	196397	163314	KNOCKATOORA COMMONS	Barrow - Ring-Barrow possible	Situated atop high ground with good panoramic views in all directions. Barely visible and much degraded site consisting of a low circular mound (diam. 1.5m; H 0.1m) enclosed by an inner fosse (Wth 3m; ext. D 0.1m) and outer bank (Wth 3m ; ext. H 0.1m). The overall diameter of the site measures 11m N-S. The small size of the mound casts some doubts on its antiquity. May have been formed by the presence of a ring-feeder though not sure, its excellent panoramic views may suggest that this is a burial monument.

TN033-065----	196020	163297	GARRANAKILKA	Barrow - Ring-Barrow possible	One of a group of four possible ring-barrows although their arrangement and state of preservation may suggest ring-feeders. Their size and siting on a steep slope and situated to a nearby ring-barrow suggests that they may be authentic ring-barrows. It would have been an unlikely location on a steep slope for a ring-feeder, local land-owner has no memory of ever using a ring-feeder in this field. Situated on the NW-facing slope of rising ground in upland area overlooking Clodiagh river valley to W, higher ground to E. Monument consists of a low circular mound (diam. 1.6m; H 0.2m) enclosed by an inner fosse (Wth 2m; ext. D 0.2m) and outer bank (Wth 3m; ext. H 0.2m) which is visible only on the downward slope side from SW through W to NW only, not visible and doubt if ever there was an outer bank on the upslope side of the barrow. Overall the monument measures 10m in diameter N-S. This barrow has a second barrow (TN033-065001) conjoined to its NE side and both of these barrows are located 20m to the E of the other two barrows (TN033-065002; TN033-065003)

TN033-065001-	196023	163305	GARRANAKILKA	Barrow - Ring-Barrow possible	One of a group of four possible ring-barrows although their arrangement and state of preservation may suggest ring-feeders. Their size and siting on a steep slope and situated to a nearby ring-barrow suggests that they may be authentic ring-barrows. It would have been an unlikely location on a steep slope for a ring-feeder, local land-owner has no memory of ever using a ring-feeder in this field. Situated on the NW-facing slope of rising ground in upland area overlooking Clodiagh river valley to W, higher ground to E. Monument consists of a low circular mound (diam. 1.8m; H 0.2m) enclosed by an inner fosse (Wth 2.5m; ext. D 0.2m) and outer bank (Wth 2.6m; ext. H 0.2m) which is visible only on the downward slope side from SW through W to NW only, not visible and doubt if ever there was an outer bank on the upslope side of the barrow. Overall the monument measures 10.5m in diameter N-S. This barrow has a second barrow (TN033-065002) located 12m to the NE and both of these barrows are located 20m to the W of the other two barrows (TN033-065; TN033-065001)

TN033-065002-	196004	163310	GARRANAKILKA	Barrow - Ring-Barrow possible	One of a group of four possible ring-barrows although their arrangement and state of preservation may suggest ring-feeders. Their size and siting on a steep slope and situated to a nearby ring-barrow suggests that they may be authentic ring-barrows. It would have been an unlikely location on a steep slope for a ring-feeder, local land-owner has no memory of ever using a ring-feeder in this field. Situated on the NW-facing slope of rising ground in upland area overlooking Clodiagh river valley to W, higher ground to E. Monument consists of a low circular mound (diam. 1.8m; H 0.2m) enclosed by an inner fosse (Wth 2.5m; ext. D 0.2m) and outer bank (Wth 2.6m; ext. H 0.2m) which is visible only on the downward slope side from SW through W to NW only, not visible and doubt if ever there was an outer bank on the upslope side of the barrow. Overall the monument measures 10.5m in diameter N-S. This barrow has a second barrow (TN033-065002) located 12m to the NE and both of these barrows are located 20m to the W of the other two barrows (TN033-065; TN033-065001)

TN033-065003-	196000	163299	GARRANAKILKA	Barrow - Ring-Barrow possible	One of a group of four possible ring-barrows although their arrangement and state of preservation may suggest ring-feeders. Their size and siting on a steep slope and situated to a nearby ring-barrow suggests that they may be authentic ring-barrows. It would have been an unlikely location on a steep slope for a ring-feeder, local land-owner has no memory of ever using a ring-feeder in this field. Situated on the NW-facing slope of rising ground in upland area overlooking Clodiagh river valley to W, higher ground to E. Monument consists of a low circular mound (diam. 1.8m; H 0.2m) enclosed by an inner fosse (Wth 2.5m; ext. D 0.2m) and outer bank (Wth 2.6m; ext. H 0.2m) which is visible only on the downward slope side from SW through W to NW only, not visible and doubt if ever there was an outer bank on the upslope side of the barrow. Overall the monument measures 10.5m in diameter N-S. This barrow has a second barrow (TN033-065002) located 12m to the NE and both of these barrows are located 20m to the W of the other two barrows (TN033-065; TN033-065001)
TN034-055----	197850	164980	BALLYNAHOW (GLENKEEN PAR.)	Ringfort - Rath possible	Situated on top of a natural rise of ground in a river valley in a mountainous region. A raised circular area (diam. 15m E-W) enclosed by an earth and stone bank (Wth 1.5m; int. H 0.3m; ext. H 1m) with slight traces of a shallow fosse. Possible entrance gap (Wth 2.5m) at NE.
TN034-056001-	199460	164860	KILLAMOYNE	Ringfort - Rath	Situated on a low natural rise of ground in a poorly drained river valley in a mountainous region. A raised circular area (diam. 31m E-W) enclosed by an earth and stone bank (Wth 1.5m; int. H 0.65m; ext. H 1m) and waterlogged external fosse (Wth 3m; D 0.2m). No entrance feature visible.
TN034-056002-	199470	164900	KILLAMOYNE	Redundant Record	Drainage features and vegetation growth show up on aerial photographs. These are non-archaeological features.

TN034-057----	199740	165780	KILLAMOYNE, ROSNAMULTEENY		Situated on the summit of a hill in a mountainous region with extensive views. An impressive bivallate earthwork consisting of a raised circular area (diam. 28m NE-SW) enclosed by two earth and stone banks with a narrow deep intervening fosse (Wth 1m; D 1m) and a causewayed entrance (Wth 3.8m) at ESE. The inner bank (Wth 3.5m; int. H 1.7m; ext. H 3-4m) is the best preserved while the outer bank (Wth 1.5m; ext. H 0.2m) is mainly reduced to a scarp and is destroyed by a modern road at N.
TN034-065----	200200	165140	CURRAGHCARROLL, DRUMGILL	Ringfort - Rath	Situated on a NW-SE ridge on a NE slope of rising ground in a mountainous region. A circular area (diam. 45m NW-SE; 38m E-W) enclosed by two earth and stone banks with an intervening fosse (Wth 1.5m; D 0.8m). The inner bank (Wth 1.2m; ext. H 1.5m; int. H 0.8m) is the best preserved while the outer bank (Wth 1.5m; ext. H 0.8m), visible from N through E to S, is elsewhere destroyed. A townland boundary bisects the site on a NE-SW axis. Quarry holes are scattered around the interior of the ringfort.
TN034-081----	198553	164262	CASTLEHILL, RUSHEEN BEG	Ringfort - Rath	Situated on a S-facing slope of rising ground in a river valley in a mountainous region. A raised circular area (diam. 34m N-S) enclosed by an earth and stone bank (Wth 2m; int. H 0.5m; ext. H 1.7m) with traces of a shallow external fosse (Wth 1m; D 0.2m). The bank is reused as a townland boundary from N to E and is reduced to a scarp in places. No clear entrance feature visible.
TN034-082----	199841	164281	RUSHEEN MORE	Enclosure	Situated on an E-W ridge on a N-facing slope of rising ground in a mountainous region. The barely discernible outline of a much degraded enclosure (approx. diam. 30m) with adjoining modern bungalow located on the site of the original conjoined enclosure to the S. No other features visible.

TN034-083----	200910	163840	GORTNAHALLA	Moated Site possible	Situated on a NW-SE ridge overlooking a river ravine below to the N. Depicted as a rectangular enclosure on the 1st ed. (1840) OS 6-inch map. Only the SE bank (Wth 2m; int. H 0.4m; ext. H 1m) of a rectangular enclosure survives (dims. 22m NE-SW; 35m NW-SE) with traces of an external fosse.
TN034-114----	199020	163460	RUSHEEN MORE	Standing Stone	Situated on top of a broad, flat ridge in upland pasture. Extensive views in all directions except to W. The stone (H 1.46m; dims. 0.93 x 0.32), composed of shaley limestone, is aligned N-S; the weathered top rises to a point. There is a hollow around the base of the stone caused by cattle.
TN034-115----	199720	163590	GORTNACRAN MORE	Fulacht Fia possible	Situated on a valley floor, in wet, marshy terrain, at the base of a steep hill which rises immediately to the SE. A much denuded mound (dims. 9m x 4.5m; H 0.15m-0.35m) with very dark soil, friable stone and small lumps of charcoal. The site has been badly poached by cattle.
TN034-117----	199434	164093	RUSHEEN MORE	Barrow - Ring-Barrow possible	Situated on a N-facing slope in pasture-land amongst some rock outcrop in an upland region. Good views of mountain valley to the N, higher ground to the S. Site consists of a roughly rectangular shaped flat-topped platform (int. diam. 6m N-S; 3.1m E-W) or mound defined by a scarp (H 0.2m) and inner fosse (Wth 1m; ext. D 0.25m) with outer bank (top Wth. 0.7m; base Wth 1m; ext. H 0.2m). The shape of the central platform is unusual for a ring-barrow, which may cast doubts about its classification. The shape of the platfrom is more like ahut site but there is no eNtrance feature and there is an internal fosse. According to local folklore from the Schools Manuscript there was a legend that there was a grave of three kings in this townland. This folklore may have been associated with this monument.

TN034-118----	198707	163654	RUSHEEN BEG	Standing Stone possible	Situated on SE-facing slope overlooking mountain valley in upland region with good view of standing stone (TN034-114) directly opposite to SE. The collpased stone (L 1m; dims. 0.65 x 0.20m), composed of limestone, is lying in a slight hollow caused by cattle poaching and was originally aligned N-S; the top of the stone rises to a point in a fashion similar to other standing stones in the region. The size of the stone and its lack of height may suggest that it is not a standing stone, however the tapering top of the stone and its relationship to the visible standing stone (TN034-114) suggest some relationship between the two monuments.
TN034-119----	198061	163420	MOGLAND	Barrow - Ring-Barrow	Situated in poorly drained land atop low hillock in upland area with panoramic views in all directions. Good views of the Devils Bit mountain to the NE, Slievenamon to the SW and Cooneen Hill. Field boundary intersects monument on an E-W axis. Monument consists of a low circular mound (diam. 6.2m E-W; 7m N-S) enclosed by an inner fosse (Wth 2m; ext. D 0.2m) and outer bank (top Wth 1m; base Wth 1.8m; ext. H 0.2m) which is intersected at N on an E-W axis. Overall dimater of monument measures 15.5m E-W; 12m N-S.
TN039-001001-	195509	162446	TOORFIBA	Standing Stone	Located on a gradual, subtle break on a NW-facing slope, in hilly pasture with a ring-barrow (TN039-001002/003) 3.6m to the SW. A standing stone of limestone composition, roughly triangular in plan, (H 1.44m; dims. 0.87m x 0.5m) aligned on a NE-SW axis. The stone tapers towards the top where part of a layer has broken away. It is quite spalled at the top. There is a grassy hummock at the base of the NW side but no evidence of stone packing.

TN039-001002-	195501	162443	TOORFIBA	Barrow - Ring-Barrow	Situated on a gradual, subtle break in a NW-facing slope in hilly terrain, under pasture. The site is in the SE corner of a field with the field ditch skirting the monument at SE and SW. A standing stone (TN039-001001) is situated 3.6m to the NE. A roughly circular site (diam. 12.1m N-S; 12.9m E-W) consisting of a central mound (Wth 3.8-5.1m; H 0.53m), a deep, U-shaped fosse (Wth 2m; D 0.5m) and an outer bank (Wth 1.5m-2.1m; ext. H 0.65m). There is evidence of a stone cist (TN039-001003) in the centre of the mound with two long slabs exposed at right angles (L 1m x Wth 0.3m and L 0.67m x 0.16m). No visible entrance feature.
TN039-001003-	195508	162455	TOORFIBA	Cist	Situated on a gradual, subtle break in a NW-facing slope in hilly terrain, under pasture. The site is in the SE corner of a field with the field ditch skirting the monument at SE and SW. A standing stone (TN039-001001) is situated 3.6m to the NE. A roughly circular ring-barrow (TN039-001002) consisting of a central mound, a deep, U-shaped fosse and an outer bank. There is evidence of a stone cist in the centre of the mound with two long slabs exposed at right angles (L 1m x Wth 0.3m and L 0.67m x 0.16m).
TN039-002----	190680	160690	KNOCKNAKILL	Ringfort - Rath	Sited on the steep SE-facing slope of a hill in rushy pasture. A roughly oval, denuded enclosure consisting of a raised area (diam. 53m N-S; 48m E-W) defined by a very low bank in the NW quadrant, otherwise discernible as a very slight scarp, a fosse (Wth 3.6m) and an earth and stone outer bank (Wth 6m; H 1.06m). The interior slopes steadily with the hillslope. There is a slight dip in the interior towards the centre.
TN039-003----	191315	160640	REISK	Megalithic Structure possible	This feature, removed sometime prior to 1884 (OS Name Book, 1904) stood on wettish ground close to the foot of Knocknabansha Hill. There are no known accounts of it. The name 'Cromlech' applied to it on the original OS 6-inch map would suggest that it may have been a megalithic tomb. (De Valera and Ó Nualláin 1982, 98, No.8)

TN039-004001-	191630	160920	REISK	Stone Circle	Situated in rough terrain on a small hillock, on a SW-facing slope, overlooking a valley. A stone circle not marked on the 1sted. (1840) OS 6-inch map but depicted on the 2nd ed. (1905). There are no visible remains of the stone circle or of the standing stone (TN039-004002) also indicated at this location on the current 6-inch map.
TN039-004002-	191630	160910	REISK	Standing Stone	Situated in rough terrain on a small hillock on a SW-facing slope, overlooking a valley. A low standing stone (H 0.8m; dims. 0.85m x 0.2m) aligned NE-SW, sloping slightly to SW. The ground level has been built up with spoil and field clearance. A stone circle (TN039-004001), no longer evident, is also named on the map at this location.
TN039-005----	192011	160813	REISK	Ringfort - Rath	Situated on a slight break in a S-facing slope in pasture. A denuded bivallate ringfort consisting of a circular area (diam. 34.5m N-S; 33m E-W) enclosed by a low bank (Wth 4m; int. H 0.13m; ext. H 1m), a U-shaped fosse (Wth 4m; D 0.43m) and outer bank (Wth 3.2m; ext. H 0.38m). Possible entrance in NE quadrant (Wth c. 2.5m) which appears to have been widened. The outer bank is not apparent along the NE quadrant - probably disturbed by adjacent NW-SE field boundary.

TN039-006001-	190155	160053	CHURCHQUARTER	Church possible	Situated on raised ground in a graveyard immediately N of Kilcommon RC church. The boundary wall of the graveyard (TN039-006002) along the N, E and W sides have been rebuilt. The ground level drops immediately NE of the N boundary wall and continues to fall gently to an adjacent river. The supposed site of the church depicted on the seventeenth-century Down Survey map is completely occupied by twentieth-century graveslabs. According to Gwynn and Hadcock the OS mistakenly identified Kilcommon, Kilnamanagh Upper Barony as the site of a Benedictine Priory, and points out that the founder's lands were in south Tipperary and that Orpen considered that Kilcommon, parish of Caher, is the site. This is taken as the correct identification. Brooks gives the date of foundation as c. 1200, with evidence that the priory continued until the reign of Edward III. It was probably abandoned soon after Glastonbury lost much of its property in Ireland in 1332 (Gwynn and Hadcock 1970, 107). During a recent graveyard clean-up scheme, however, portion of an ogee-headed window was found (pers. comm. Richard O' Brien) which may indicate the presence of a medieval church.

TN039-006002-	190150	160060	CHURCHQUARTER	Graveyard	Situated on raised ground in a graveyard immediately N of Kilcommon RC church. The boundary wall of the graveyard along the N, E and W sides have been rebuilt. The ground level drops immediately NE of the N boundary wall and continues to fall gently to an adjacent river. The supposed site of the church (TN039-006001) depicted on the seventeenth-century Down Survey map is completely occupied by twentieth-century graveslabs. According to Gwynn and Hadcock the OS mistakenly identified Kilcommon, Kilnamanagh Upper Barony as the site of a Benedictine Priory, and points out that the founder's lands were in south Tipperary and that Orpen considered that Kilcommon, parish of Caher, is the site. This is taken as the correct identification. Brooks gives the date of foundation as c. 1200, with evidence that the priory continued until the reign of Edward III. It was probably abandoned soon after Glastonbury lost much of its property in Ireland in 1332 (Gwynn and Hadcock 1970, 107). During a recent graveyard clean-up scheme, however, portion of an ogee-headed window was found (pers. comm. Richard O' Brien) which may indicate the presence of a medieval church.
TN039-007----	191280	159980	KNOCKNABANSHA	Megalithic Tomb - Wedge Tomb	Situated in a small clearing in a plantation on the western slope of Knocknabansha Hill. It consists of the remains of a gallery aligned SW-NE, now 2.1m long and some 0.7m wide, formed by two opposed sidestones and a septal-stone outside the SW end of the more southerly sidestone may represent a doubling of the gallery wall. A slight depression in the ground extending about 1.5m beyond the E end of the structure may indicate that the gallery was originally longer. There are a number of displaced stones at the site. (De Valera and Ó Nualláin 1982, 89, No.8)

TN039-008----	192560	159870	KNOCKMAROE	Megalithic Tomb - Wedge Tomb	Situated close to the foot of the S-facing slope of Knockmaroe Hill. The remains consist of a mound about 9m in diameter and 1m high with a hollow towards its western perimeter where there are three stones. One of these is an orthostat aligned WSW-ENE. This stone, which declines in height from W to E, may have formed part of a chamber side. Resting against the last is a large slab, possibly a displaced roofstone. A thin slab beneath this may have been detached from its underside. Some stons exposed at the edge of the hollow and at the perimeter of the mouond are of uncertain origin. The scant remains seem to be those of a wedge tomb. (De Valera and Ó Nualláin 1982, 89, No.9)
TN039-009----	195079	160943	KNOCKCURRAGHBOLA COMMONS	Megalithic Tomb - Wedge Tomb	Situated on a hillock at the NE end of a low ridge. It consists of a long, narrow, partly roofed gallery closed at the SW by a septal-stone. Both sides of the gallery are flanked by outer-walling with the more westerly stone at either side set in advance of the septal-stone. These two stones would have served as the sides of a portico or, alternatively, represent a doubling of the portico sides since removed.The structure is 7m in overall length. The main chamber, open at its more easterly end, is 5.3m long and 1.2m wide at the septal-stone whence it narrows slightly towards the E.Two roofstones cover its forward end. There are five sidestones on the N side and three on the S side. There are six outer-wall stones to the N and four to the S. These are set close to the gallery walls and two of those to the N double as buttress-stones. Beyond the easternmost at the S there is a small stone which may be the butt of a taller one, probably another outer-wall stone. There are traces of a mound around the structure. A large retangular slab lies prostrate at the SW end of the gallery. (De Valera and Ó Nualláin 1982, 90, No.10)

TN039-010----	196809	159771	SHEVRY	Castle - Ringwork possible	Situated on a break in the SE-facing lower slope of a hill in undulating pasture. A roughly rectangular earthen mound (H 2.15m; base dims. 21m x 15.5m; top dims. 15.5m x 10.3m) which tapers towards the NE side with a deep central depression (D 1.23m). The mound is fairly steep-sided, particularly along the SW side and at the NW corner. It is badly disturbed by quarrying in the centre. No outer fosse or defences visible.
TN039-011001-	196790	159630	SHEVRY	Barrow - Pond Barrow possible	Situated on the summit of a natural rise, close to the W edge of a gradual fall, overlooking a valley at the base of the slope. The site consists of a flat central area (14.3m N-S; 15m E-W) enclosed by a compact earthen bank (Wth 2.3m; int. H 0.35-0.55m; ext. H 0.18-0.35m), less visible at S. An entrance gap (Wth 3m) is visible at ESE. There is a small standing stone (TN039-011002) in the interior in the SW sector with a second stone (TN039-011003) standing at the entrance at ESE, in line with the outer edge of the bank.
TN039-011002-	196797	159635	SHEVRY	Standing Stone	Situated on the summit of a natural rise, close to the W edge of a gradual fall, overlooking a valley below. A small standing stone (H 1m; max. dims. 0.83m x 0.5m) of limestone composition located in the SW quadrant of the interior of a possible pond barrow (TN039-011001). The standing stone is aligned on a N-S axis and is roughly trapezoidal in plan. There is a slight hollow around the base with no evidence of packing-stones. There is a second standing stone (TN039-011003) nearby at the entrance to the barrow in the ESE quadrant.

TN039-011003-	196790	159630	SHEVRY	Standing Stone	Situated at the entrance to a possible pond barrow (TN039-011001) on the summit of a natural rise, close to the W edge of a gradual fall, overlooking a valley below. A rectangular standing stone (H 1.3m; dims. 0.63m x 0.34m) of limestone composition aligned on an E-W axis. There is a slight hollow around the base with no evidence of any packing-stones. The top of the stone tapers to a point from W to E. A second standing stone (TN039-011002) is situated in the interior of the same barrow.
TN039-014----	190725	159210	LOUGHBRACK	Megalithic Tomb - Wedge Tomb	Situated on a level tract of wettish ground between Loughbrack and Knocknabansha Hills. Many gallery orthostats are missing but outer-walling, doubled at both sides, is well preserved and indicates a diminution in height and width towards the E. A large septal-stone at the W and adjoining it a long sidestone to the N and two alongside to the S remain of the gallery. The short surviving length of gallery is 1.3m wide. Immediately forward of the N end of the septal-stone there is a small transversely set stone. Almost 7m E of the septal-stone a transverse stone links the inner lines of the outer-walls. This stone may be part of the outer-walling though it could be the backstone of the gallery. The inner line of outer-walling at the S is represented by six stones. Outside and flanking the eastern half of this and extending further to the E there is an outer line of seven thin stones. Six stones of an inner line of outer-walling remain on the N side of the monument and there are four stones of an outer line. Just W of mid-length a further stone sits in the gap between these two lines. Opposed single stones extend the inner lines of outer-walling beyond the eastern transverse slab. A displaced slab lies between the surviving gallery sidestones and another rests against the eastern transverse stone. Low traces of a mound surround the structure.

TN039-016----	193966	159479	KNOCKCURRAGHBOLA COMMONS	Megalithic Tomb - Wedge Tomb	Sited on a S-facing slope in farmland. A narrow, SW-facing, wedge-shaped gallery flanked at either side by outer-walling survives. There are slight traces of a mound along the S side of the structure. The gallery, at least 4.2m long, is open at both ends. It narrows from 1m wide at the SW to 0.65m at the NE and a diminution in the height of the gallery orthostats in the same direction is also indicated. Four orthostats survive along both sides of the gallery. Two of those on the S side have split into two or more separate uprights. Four outer-wall stones flank the S side of the gallery. The easternmost is set inside the line of the other three and adjoins the gallery wall. Six outer-wall stones flank the N side of the gallery, a number of them also split into separate uprights. Two transversely set stones seem to mark the end of this line of outer-walling. A number of partly concealed slabs lie to the W of the structure. (De Valera and Ó Nualláin 1982, 92, No.13)
TN039-017----	194150	159500	KNOCKCURRAGHBOLA COMMONS	Megalithic Tomb - Wedge Tomb	Sited 200m E of the a wedge tomb (TN039-016) and on the same S-facing slope. The scant remains consist of a septal-stone at the WSW, two sidestones of the more southerly side of the chamber and one of the opposite side. Another stone a little to the E of the last is somewhat loosely set and of uncertain origin. A small, low mound adjoins the S side of the chamber. The origin of a number of displaced stones at the site is uncertain. (De Valera and Ó Nualláin 1982, 91-2, No.12)
TN039-018----	195100	158790	GRANIERA	Megalithic Tomb - Unclassified possible	Situated on an E-facing slope. An orthostat 1.2m high and aligned NE-SW, stands here. Another stone, probably but not certainly in situ, leans against its more southerly face. There are traces of a mound around the stones. The two stones might be the remnants of a megalithic tomb. (De Valera and Ó Nualláin 1982, 99, No.11)

TN039-019----	196890	159430	SHEVRY	Enclosure possible	Situated on a natural platform with ground falling fairly steeply in all directions except to W, in an area of rough pasture. Depicted as an irregular-shaped enclosure on the 1st ed. (1840) OS 6-inch map but not indicated on the 1905 ed. The area where the enclosure was located is quite disturbed and uneven with a suggestion of lazy bed cultivation and the remains of a bank along portion of the W side - this appears to be part of an old field bank. Not visible at ground level.
TN039-027----	194280	159060	GRANIERA	Enclosure possible	Situated on the SE slope of a flat-topped hill which falls steeply to a valley below. Identified as a roughly circular enclosure on an aerial photograph taken in 1974 (GSIAP, R 360/359). Not visible at ground level. The landowner does not recollect any site in this field.
TN039-035----	191880	161100	REISK	Barrow - Ring-Barrow	Situated on the gentle SW-facing slope of a hill, in pasture. A circular site (12.8m N-S; 12.8m E-W) consisting of a central mound (diam. 4.8m; H 0.26m), a narrow, U-shaped fosse (W 1.7m; D 0.86m) and an outer bank (W 2m; ext. H 0.14m). The bank is steep-sided and the fosse is well defined with some rushes growing in it.
TN039-036----	194350	162730	CUMMER	Barrow - Pond Barrow	Located on a break in a N-facing slope in wet, upland terrain. A circular depression (diam. 24m N-S; 21m E-W) enclosed by a broad, flat bank (Wth 3.6m; int. H 0.35m; ext. H 0.18m). An old, low, earthen field bank extends N-S through the S half of the site. The interior is very wet and has been badly eroded by cattle. There is a small circular enclosure (diam. 13m) adjoining the NW quadrant. It is enclosed by a very low earthen bank except where it shares the pond barrow's bank.

TN039-037----	194260	159270	KNOCKCURRAGHBOLA COMMONS	Megalithic Tomb - Unclassified possible	Sited just 200m S of wedge tomb (TN039-017) in a prominent position on a hillock in upland pasture. The remains are scant perhaps because of deliberate disturbance that may account for a subcircular depression measuring some 7m x 6m and at least 0.3m deep on top of the hillock. At the northern edge of the depression there is a low orthostat aligned WNW-ESE. It is 1.45m long, 0.15m thick and slopes from 0.65m high at its more westerly end to 0.15m at the opposite end. Some 0.5m S of this there is a prostrate slab 1.6m in maximum dimension while 5-7m to the SW there are three irregularly spaced stones, possibly representing a kerb. The diminution in height of the orthostat from W to E would suggest it could be the surviving remnant of the gallery side or outer-wall of a wedge tomb.
TN039-038001-	196600	160490	SHEVRY	Barrow - Ring-Barrow	Situated on a break in an E-facing slope in upland terrain, under pasture. Extensive views in all directions except upslope to SW. A circular area (diam. 11.5m N-S; 11.4m E-W) consisting of a central mound (diam. 4.6m N-S; 4.7m E-W; H 0.23m) enclosed by a water-logged fosse (Wth 1.6m; D 0.26m) and well-preserved outer bank (Wth 1.9m; H 0.3m), partially denuded in the SE quadrant. There are three stones embedded in the N half of the central mound which appear to be set on edge, possibly indicating the presence of a cist (TN039-038002).
TN039-038002-	196600	160490	SHEVRY	Cist possible	Situated on a break in an E-facing slope in upland terrain, under pasture. Extensive views in all directions except upslope to SW. A circular Aring-barrow (TN039-038001) consisting of a central mound enclosed by a water-logged fosse and well-preserved outer bank, partially denuded in the SE quadrant. There are three stones embedded in the N half of the central mound which appear to be set on edge, possibly indicating the presence of a cist.

TN039-043----	194330	159600	KNOCKCURRAGHBOLA CROWNLANDS	Standing Stone possible	Situated on a poorly drained S-facing slope of rising ground in an upland region. A narrow standing stone (H 1.25m; 0.25m x 0.2m) which is rectangular in plan with its long axis orientated N-S. The stone is unusually narrow and may have been erected as a scratching post.
TN039-044----	194270	159400	KNOCKCURRAGHBOLA COMMONS	Standing Stone	Situated on flat elevated pasture with good views in all directions. A triangular shaped standing stone (H 1.26m; 1m x 0.2m) which is rectangular in plan with its long axis orientated E-W.
TN039-045----	194000	159270	KNOCKCURRAGHBOLA COMMONS	Megalithic Tomb - Unclassified possible	Situated on a low rise of ground overlooking a river valley in an upland region. A chamber, 1.35m long (SSE-NNW) is 0.85m wide at the open SSE end and narrows slightly towards the opposite end. It is formed by four low stones, one at the more westerly side, one at the NNW end, and there are two, a longer outer and shorter inner example, at the more easterly side. The shorter of the latter two stones is skewed so as to narrow the rear of the chamber. There is a largely concealed stone at the inner face of the last. The structural stones are relatively thin slabs and none rises more than 0.25m above ground level. This seems to be a large cist.
TN039-046----	196543	161770	KNOCKNAMENA COMMONS	Barrow - Ring-Barrow	Situated on top of high ground in upland region with good panoramic views in all directions. Much degraded monument consisting of a barely visible circular mound (diam. 8m N-S) enclosed by an inner fosse (Wth 2m; ext. D 0.2m) and slight traces of an outer bank (Wth 1m). A field boundary bisected the monument on a N-S axis. This field boundary has since been levelled. Monument is barely visible in the winter months and is probably not visible during the summer months.

TN039-047----	196619	162022	KNOCKNAMENA COMMONS	Enclosure possible	Situated in pasture on E facing slope overlooking mountain valley in upland region, higher ground to W of enclosure. A roughly rectangular-shaped area (int. dims. 19m E-W; 20m N-S) enclosed by an earthen bank (Top Wth 1m; base Wth 2m; int. H 0.1m; ext. H 0.3m) with slight traces of an outer fosse, no entrance feature visible. Quarry in NE quadrant of enclosure. Possible linear field boundaries intersect enclosure along its S side. Possible summer grazing enclosure or booley site for upland grazing during the summer months.
TN039-048----	196849	162153	GLENBEG	Barrow - Ring-Barrow	Situated in pasture, on a SE-facing slope of rising ground in a mountainous region. Well preserved monument consisting of a raised circular area (diam. 4m N-S; 3.7m E-W; H 0.3m) with sunken depression (diam. 3m) on top of mound, defined by an inner fosse (Wth 1m; ext. D 0.2m) with the slightest traces of an outer bank, only visible in places. Overall diameter 8m N-S. Central depression may be due to collapsed cist in centre of mound.
TN039-049----	196939	159636	SHEVRY	Barrow - Ditch Barrow possible	Situated in wet marshy pasture, atop low hillock with good views of Devils Bit to NE in mountian valley running NE-Sw in upland region. Well preserved possible ditch-barrow consisting of a circular mound (top diam. 9m NW-SE; base diam. 13m NW-SE; H 0.3m) and fosse (base Wth 5m; top Wth 9m; ext. D 0.45m) with no traces of an outer bank. Overall diameter measures 31m NW-SE.

TN039-050----	194897	160291	KNOCKCURRAGHBOLA COMMONS	Megalithic Tomb - Unclassified possible	Situated in upland region, in pasture with good panoramic views in all directions, view of Galtee More to the SW on a clear day. Good views of Wedge tomb (TN039-009) located 670m to N. A roughly rectangular chamber, 1m long by 0.85m wide and 0.3m high at the open SW end formed by four low upright stones with a large capstone (H 0.55m; L 2m; Wth 2m) sitting on top of the side stones. A second capstone may be a displaced roofstone from the SW end of the chamber. Not clear whether this is a megalicthic tomb or not however the arrangement of the capstone sitting on side stones forming a chamber suggests that it is a possible megalithic structure. It also has an impressive siting in the landscape with fine panoramic views of hilltops within this mountain region.
TN039-051----	195214	160729	KNOCKCURRAGHBOLA COMMONS	Fulacht Fia	Situated in wet marshy field in upland area with stream immediately to the S, field has recently been planted with conifer trees. Possible two stone row (TN039-052) and wedge tomb (TN039-009) to NW. During the planting of trees in this field a drainage ditch (Wth 0.70m; D 0.40m) was cut through the middle of the mound on an E-W axis revealing the burnt material of the monument. The monument consists of a large circular mound (diam. 16m N-S ; 20m E-W; H 1m) of burnt material with stream immediately to S of mound. No visible sign of any trough.
TN039-052----	195131	160825	KNOCKCURRAGHBOLA COMMONS	Stone Row possible	Situated in pasture on SE facing slope of rising fround in upland area with good views of mountian valley to S and E, higher ground to N. Nearby wedge tomb (TN039-009) to NNW and fulacht fiadh (TN 039-051) to SE. Monument consists of two low limestone orthostats, aligned E-W, and 2.48m apart. Both stones are roughly triangular in shape with rectangular sections and the tops of the stones are tapering towards a point. The W stone measures 0.9m H; 0.58m x 0.21m. The E stone measures 0.8m H; 0.60m x

					0.30m. Local landowner has no recollection that they were ever erected as scratching posts for livestock.
TN039-053----	193696	157544		Standing Stone(s)	Redundant Record
TN039-054----	194926	157511		Hut Site	Redundant record
TN039-055----	194615	157281		Fulacht Fia	Redundant record
TN039-056----	196928	158409	CURRAGHNATINNY	Fulacht Fia	Situated in wet marshy valley in upland area with nearby stream to the W and well to the NW. Large horseshoe-shaped mound of burnt material which was impossible to examine due to dense cover of vegetation at time of visit.
TN040-001----	197793	162562	KNOCKNAMENA COMMONS	Ringfort - Rath	Situated on the E-facing slope of a hill in pasture. An oval bivallate enclosure (diam. 40.7m N-S; 34.5m E-W) enclosed by a bank (Wth 2.3m; int. H 0.2m; ext. H 0.75m), a U-shaped fosse (Wth 3.2m; D 0.74m) and an outer bank (Wth 2.9m; ext. H 0.6m). A causewayed entrance at E (Wth 4.3m) may have been widened for tractor access. The outer bank is incorporated into a field boundary at W, N and NE.
TN040-002----	197944	162305	GORTNADA	Ringfort - Rath	Situated on a break in a gentle S-facing slope, near the summit of a hillock, in pasture. A roughly circular bivallate site (diam. 24m N-S; 22.4m E-W) enclosed by a bank (Wth 2.4m; int. H 0.28m; ext. H 0.92m), a U-shaped fosse (Wth 3.11m; D 0.8m) and a denuded outer bank (Wth 2.8-3.5m; ext. H 0.32m) with a causewayed entrance (Wth 3m) in the SE quadrant. There are old field boundaries adjacent to the site at W and NW and a farm roadway built at NE has damaged the inner bank. There is a roughly circular hollow (Wth c. 9m) in the interior in the SE quadrant.

TN040-003----	198580	162640	CAREW	Barrow - Bowl-Barrow	Situated on the crest of a low hill, in pasture. A roughly circular mound (base diam. 12.5m N-S; top diam. 7m; H 1.55m) enclosed by a U-shaped fosse (Wth 2.6m; D 0.5m). Whitethorns are growing on the summit and around the edge of the site. There may have been quarrying into the summit at some stage (though not in memory of present landowner) with upcast around the edge of the summit to the SE and SW. A large boulder lies prostate at the outer edge of the fosse at N.
TN040-004----	198810	161199	CAPPANALEIGH	Church	Situated on high ground on top of a hillock which slopes SE down to the main graveyard. The church was formerly located in the NW corner of the graveyard (TN040-004001) but the area is now occupied by burials and headstones, the earliest dated 1700. It was marked as Templeougher (site of) on the 1903 ed. OS 6-inch map. There are no architectural fragments visible in graveyard which has been extended southward. There are at least two eighteenth-century headstones (dated 1734 and 1761) in the NE quadrant, otherwise the headstones date to the nineteenth and twentieth centuries.
TN040-004001-	198832	161192	CAPPANALEIGH	Graveyard	Situated on high ground on top of a hillock which slopes SE down to the main graveyard. The church (TN040-004) was formerly located in the NW corner of the graveyard but the area is now occupied by burials and headstones, the earliest dated 1700. It was marked as Templeougher (site of) on the 1903 ed. OS 6-inch map. There are no architectural fragments visible in graveyard which has been extended southward. There are at least two eighteenth-century headstones (dated 1734 and 1761) in the NE quadrant, otherwise the headstones date to the nineteenth and twentieth centuries.

TN040-016----	197901	159386	CURRAGHDUFF (UPPERCHURCH PAR.)	Castle - Tower House	Situated on the N spur of a break in a N-facing slope, in pasture. A stream runs N-S at the base of the slope immediately to the E. The site has been levelled, however, faint indications of foundations (dims. c. 15.4m N-S; Wth c. 2m) are still visible though less so on the E side. According to the OS Letters nothing remained of the castle called 'Caislean Cruinn', though its location was known locally (O'Flanagan 1930, vol. 1, 187).
TN040-028----	197660	157070	KNOCKACARHANDUFF COMMONS	Redundant Record	Possible enclosure identified on aerial photograph (GSI 16.4.1974, R 358/9). Site non-archaeological. Natural, fairly circular low hill on break of slope.
TN040-039001-	199580	161240	GORTNASKEHY (UPPERCHURCH PAR.)	Cist	Situated on the flat summit of Moher Hill overlooking a broad valley to the SW and panoramic views from E through S to W. A denuded circular cairn (dims. 10.1m N-S; 10.5m E-W) defined by occasional small stones and a slight scarp. The cairn covers a recently exposed cist (L 0.82m x Wth 0.6-0.76m; D 0.8m), aligned NE-SW, trapezoidal in plan, with the wider end to SW. There is a large rectangular capstone (2.15m x 0.96m; T 0.21m) of sandstone with quartz pebble inclusions. Four flat sandstone slabs (av. H 0.5m) set on edge line the cist (sidestone at SW end is 0.17m T). A depth of 0.2m of soil has recently been removed from the base and a flag floor which paved the bottom has been broken through. According to local information the soil covering the flag floor had been very dry. A small quantity of charcoal was found in the disturbed soil.
TN040-039002-	199580	161240	GORTNASKEHY (UPPERCHURCH PAR.)	Cairn	Situated on flat summit of Moher Hill overlooking broad valley to SW and panoramic view from W-S-E. Denuded circular cairn (10.1m N-S; 10.5m E-W) defined by occasional small stones and slight scarp. Cairn covers a recently exposed trapezoidal cist with large rectangular capstone (see TN040-039001 for description).

TN040-040001-	197630	161230	COOGA	Barrow - Ring-Barrow	Situated in flat terrain on a valley floor in poorly drained land, under pasture. A roughly circular ring-barrow (diam. 19.1m N-S; 17.8m E-W) consisting of a circular mound (diam 10.7m; 0.42m H) enclosed by a fosse (Wth 2-2.5m; D 0.37m) and outer bank (Wth 1.5m at crest, 3.7m at base; ext. H 0.31m). The mound has a central depression probably due to cattle erosion. A standing stone (TN040-040002) lies prostrate in the fosse at W and the outer bank is not visible at this point. Some stone protrudes from the central mound. According to local tradition this is the burial site of the 'Great Dane' and was part of the 'Jewel of Dane' estate. The fosse and central depression become waterlogged in the winter.
TN040-040002-	197630	161230	COOGA	Standing Stone	Situated in flat terrain on a valley floor in poorly drained pastureland. A collapsed standing stone (L 1.96m; dims. 0.56m x 0.45m) which lies partially embedded in the fosse of a ring-barrow (TN040-040001) in the W quadrant. There are deep linear scores on both exposed corners. The third corner, which is partially embedded, doesn't appear to have any markings. The lines do not conform to ogham script, however, in the nineteenth century there were incidences of standing stones being scored with false 'ogham script' to confound antiquarians (pers. comm. F. Moore). The stone was standing in recent memory according to local information.
TN040-041----	200452	162504	FINNAHY	Fulacht Fia	Situated in a small, boggy valley with hills rising to E and W; a small stream ran down the centre of this valley. The site is in rough, wet pasture immediately N of a cut-away bog. An impressive horseshoe-shaped mound of burnt material (dims. 12m N-S; 12.8m E-W; H 0.8m) with a depression (dims. 5m N-S; 2.8m E-W), presumably for a trough, facing N.

TN040-042----	197883	162490	GORTNADA	Standing Stone	Situated just below the crest of a hill on ground sloping very gradually to the S, in meadow. Limestone standing stone orientated on a NE-SW axis, roughly rectangular in plan (H 0.83m at apex; max. dims. 1m x 0.44m) with top sloping up to SW. The stone is spalling to some degree, particularly on the SE face. There is a grassy hummock around the base of the standing stone but no obvious packing-stones.
TN040-046001-	197510	162130	KNOCKNAMENA COMMONS	Enclosure	A large semicircular enclosure situated on a SE-facing slope of rising ground in an upland area overlooking a mountain valley with higher ground above the site to the N. Originally a circular enclosure, the present remains consist of a semicircular area (dims. 52m SE-NW; 60m E-W) enclosed by a bank (Wth 5m; int. H 0.25m; ext. H 0.7m) and external fosse (Wth 5m; D 0.3m) which survives from NW through N to SSE. The site is intersected by a road from SSE to S running along an E-W axis and from S to W by a field boundary aligned on a N-S axis. No entrance feature visible.
TN040-046002-	197510	162130	KNOCKNAMENA COMMONS	Barrow - Ditch Barrow possible	Situated on a poorly drained SE-facing slope of rising ground in an upland area with a nearby enclosure (TN040-046001) 70m to the S. A low flat-topped mound (diam. 4.2m NE-SW; 4.4m E-W; H 0.45m) enclosed by a shallow water-logged fosse (Wth 2.4m; D 0.1m) with no evidence for an external bank.
TN040-047----	197530	160970	COOGA	Barrow - Ring-Barrow	Situated in a prominent position on top of a hillock in upland pasture, with extensive views in all directions except upslope to NW. This site has been ploughed over but is still visible. It consists of a circular mound (diam 3.3m; H 0.08m) enclosed by a water-logged and silted fosse (Wth 3m; D 0.3m) and outer bank (Wth 2.8; ext. H 0.2m) (overall diam. 16.1m N-S: 16m E-W). The outer bank is most denuded in the NW quadrant.

TN040-048----	198190	161230	CAPPANALEIGH	Fulacht Fia	Situated in wet, marshy upland terrain with a channalised stream c. 10m to the NE. A classic horseshoe-shaped mound of burnt material (dims. 7m NNE-SSW; 7.5m ESE-WNW; H 0.25m); opening (dims. 3.5m NNE-SSW; 3.5m ESE-WNW) faces SSW. A small area of possible burnt material lies c. 200m to the SE
TN040-051----	197726	157788	FOILAGOULE	Fulacht Fia	Situated on wet S facing slope of rising ground in upland area with steep cliff-edge forming S boundary of site. Semi-circular shaped mound (H 0.7m; base diam. 4m N-S; base diam. 10m E-W; top diam. 3m) of burnt material with the cliff edge forming the S boundary of the mound.
TN040-052----	198055	157380	KNOCKACARHANDUFF COMMONS	Earthwork	Situated in upland area on W facing slope of rising ground with good extensive views to W and higher ground to E. Field boundary intersects earthwork at S running along an E-W axis. Present remains consist of a semi-circular sunken wet area (dims. 4.5m N-S; D 0.2m) enclosed by a low earthen bank (top Wth 1m; base Wth 2m; ext. H 0.4m) with faint traces of an outer fosse, no entrance feature visible. The enclosing bank and outer fosse are destroyed along the S side of the site by the field boundary which runs along an E-W axis. May be the remains of a much degraded possble ring-barrow or could be the remains of a possible square-shaped hut site (ext. dims. 6m E-W) that has been truncated by a field boundary.
TS039-015----	192418	158421	CUMMER MORE	Enclosure possible	On a poorly drained marshy W facing slope of rising ground in upland area. This possible enclosure is not visible at ground level. Though this is an unlikely location for an archaeological monument, a roughly circular enclosure (diam. c. 15m) is depicted on the 1st ed. (1840) OS 6-inch map.

TS039-029----	194643	156810	AUGHVALLYDEAG	Ringfort - Rath possible	On a poorly drained E-facing slope of rising ground in an upland area with good views from the N-E-S. This monument, identified from an aerial photograph (GSI, R. 360/59; 16/04/74), was heavily overgrown with reeds at the time of inspection. The monument consists of a low sunken circular area (diam. 11.5m; ext. D 0.1m) with traces of a second bank (Wth 2m; ext. H 0.3m) only visible at the SE.
TS045-003----	193263	156167	BOOLANUNANE	Enclosure possible	On NNE facing slope of rising ground in upland area overlooking river valley. Good extensive views from NW through E to S. No surface remains visible. Monument identified from aerial photographs (GSI 360/59, 16/04/74) as a circular enclosure.
TS045-004----	194230	156366	REAFADDA	Enclosure possible	Just below summti of hill on W facing slope of rising ground in upland area overlooking river valley. Nearby enclosure (TS045-005----) to SW. No surface remains visible. Monument identified on aerial photograph (GSI, 360/59; 16/04/74) as a circular enclsoure.
TS045-005----	193971	156135	REAFADDA	Enclosure possible	On poorly drained W facing slope of rising ground in upland area with ravine immediately N and enclosure (TS045-004----) to NE. No surface remains visible. Monument identified from aerial photograph (GSI, 360/59; 16/04/74) as a circular enclosure.
TS045-026----	195440	156110	TURRAHEEN UPPER	Barrow - Ring-Barrow	On flat partially reclaimed grassland in upland area with good views to the E. The ring-barrow consists of a well preserved low circular flat-topped platform(diam. 4m N-S; 4m E-W; H 0.2m) enclosed by an inner fosse (base Wth 1.5m; top Wth 3m; ext. D 0.2m) and outer bank (base Wth 4m; top wth 2.5m; ext. H 0.4m). Overall diameter 12.9m NW-SE; 11.1m SW-NE.

TS046-001----	197145	156203	TURRAHEEN UPPER	Enclosure	On a SE-facing slope of Gortmore Hill overlooking Turaheen river valley in an upland region. Enclosure was inaccessible due to its location in a Coillte conifer plantation. The monument is visible as an enclosure on aerial photographs (GSI R 359/8, 16/04/74). An inspection in 1994 described this monument as an enclosure (diam. C.50m) defined by a low bank (Wth c. 3-4m; H 0.5m) and shallow external fosse (Wth 3-4m) which is tangential with roadside level along the S quadrant and remains of the external bank are visible along the SE sector. The enclosure had been recently shallow ploughed and planted with conifers and a new forest access road constructed to the SE of monument.

APPENDIX 12-II

NIAH RECORDS WITHIN VICINITY OF THE PROPOSED DEVELOPMENT.

Note these are located in the villages of Upperchurch and Milestone and will not be impacted upon by the proposed development.

Tipperary North - Thu May 17 16:31:56 IST 2012

Main Record - Tipperary North

Milestone, Tipperary North

22403906

Reg. No.	22403906
Date	1760 - 1800
Previous Name	N/A
Townland	GRANIERA
County	Tipperary North
Coordinates	194385, 158239
Categories of Special Interest	ARCHITECTURAL SOCIAL TECHNICAL
Rating	Regional
Original Use	milestone/milepost
In Use As	milestone/milepost

Description
Triangular-profile limestone milestone, c. 1780. Inscribed 'Newport 15 Miles, Thurles 13, Tipper[ary] 16' on front faces. Recent rubble limestone setting at junction of two roads.

Appraisal
This milestone is a physical reminder of the era when the post office operated a coach-based system of postal distribution. The naming of the village after the milestone is evidence of the historical significance of the feature. The simple form and well-executed Roman letting of the carving exhibit fine craftsmanship. It is attractively set with a rubble stone wall constructed to protect it from damage.

Back To Results

Main Record - Tipperary North

Saint Patrick's National School, Upperchurch, Tipperary North

22404005

Reg. No.	22404005
Date	1950 - 1960
Previous Name	N/A
Townland	GORTATOODA
County	Tipperary North
Coordinates	198741, 161486
Categories of Special Interest	ARCHITECTURAL SOCIAL
Rating	Regional
Original Use	school

Description
Detached six-bay double-height national school, built c. 1955, now disused. Four-bay single-storey flat-roofed block to rear and whole flanked by flat-roofed porches to gable ends with concrete canopies over doors to sides. Sprocketed slate roof with roughcast rendered chimneystack, and cast-iron rainwater goods. Roughcast rendered walls with rendered plinth and slate date plaque. Square-headed openings with six-over-six pane timber sash windows and concrete sills. Timber battened doors. Flat-roofed rendered concrete block playground shelter with open front with round columns. Bounded by roughcast rendered walls with concrete stile and steel gates.

Appraisal
A variation of the standard design for national schools built throughout the twentieth century, the building is a successful attempt to design in sympathy with the vernacular architectural tradition of rural Ireland, by using simple forms and a limited palette of materials. This former school retains many of its original features and materials such as the timber sash windows, timber door and bootscrape, date plaque, pedestrian stile, steel gates and playground shelter.

Main Record - Tipperary North

Saint Mary's Roman Catholic Church, Upperchurch, Tipperary North

22404006

Reg. No.	22404006
Date	1925 - 1930
Previous Name	N/A
Townland	CAPPANALEIGH
County	Tipperary North
Coordinates	198753, 161297
Categories of Special Interest	ARCHITECTURAL ARTISTIC HISTORICAL SOCIAL
Rating	Regional
Original Use	church/chapel
In Use As	church/chapel

Description

Detached five-bay two-storey over half basement house with dormer attic, built 1784, with lower two-storey return and with lean-to extensions to rear and north gable. Pitched slate roof to slightly-raised overhanging eaves, having slated roofs and sides to dormers, and rendered chimneystacks to gable ends. Corrugated-iron roofs to extensions. Rendered rubble limestone walls, with rendered brick to return and to one extension. Replacement aluminium windows to slightly-widened openings to front wall and replacement uPVC to basement. Few and recent windows and one blocked window to rear wall. Limestone block-and-start door surround having date to keystone "1784", spoked fanlight, and with flight of limestone steps leading to timber panelled door.

Appraisal

Saint Mary's Church is a well-designed church, using a modern interpretation of traditional forms and details to create a building of significant architectural quality. It contains elements of artistic value, including the stained glass to the east window of 1928, possibly from the Harry Clarke studio.

Main Record - Tipperary North

Upperchurch, Tipperary North

22404008

Reg. No.	22404008
Date	1965 - 1970
Previous Name	N/A
Townland	CAPPANALEIGH
County	Tipperary North
Coordinates	198793, 161237
Categories of Special Interest	ARTISTIC SOCIAL TECHNICAL
Rating	Regional
Original Use	shrine/oratory/grotto
In Use As	shrine/oratory/grotto

Description

Freestanding grotto, built 1967. Composed of random rubble limestone, with three segmental-arched recesses of various sizes, one containing a statue of the Blessed Virgin Mary, another an altar. Stone paving to front. Bounded by a pebbledashed wall with rendered piers and concrete capstones and steel railings.

Appraisal

This grotto, located in a very prominent position in the village, on an elevated site opposite the cemetery, and near Saint Mary's Church, is a dominant feature of the streetscape. The stonework forming the grotto is well executed, and adds artistic interest to the site.

Upperchurch Windfarm Environmental Impact Statement

Main Record - Tipperary North

Upperchurch, Tipperary North

22404009

Reg. No.	22404009
Date	1860 - 1880
Previous Name	N/A
Townland	ROAN (UPPERCHURCH PR)
County	Tipperary North
Coordinates	198350, 160506
Categories of Special Interest	ARCHITECTURAL SOCIAL
Rating	Regional
Original Use	house
In Use As	house

Description

Detached four-bay two-storey house, built c. 1870, with single-storey extension to rear and flat-topped windbreak to entrance. Lobby-entry plan. Hipped slate roof with rendered chimneystacks. Pebbledashed walls to first floor and rear and smooth rendered to ground and gables, with render quoins and plinth to front. Square-headed openings with two-over-two pane timber sash windows with stone sills to front elevation and replacement uPVC windows to rear. Former five-bay single-storey with loft vernacular house, built c. 1800, to south-west, now used as farm building and having lean-to extension to south. Pitched slate roof with carved timber bargeboards, windbreak with lean-to slate roof, rubble sandstone walls, two-over-two pane timber sash windows with stone sills and retaining interior features including wide hearth with iron crane and wheel bellows. Single-storey rubble outbuildings with pitched slate roofs to site.

Appraisal

This layout of this complex of buildings, comprising the original house and outbuildings ranged to form a courtyard, and the later two-storey house constructed adjacent, shows the typical historical development of rural farmyards in the local vernacular idiom. The older house and outbuildings contain intact original features, including the fireplace with bellows and crane and the later house provides interest to the local roadscape.

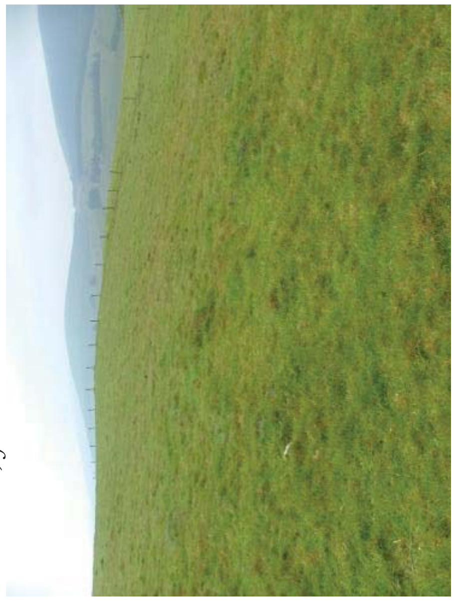
APPENDIX 12-III: PHOTOGRAPHS OF FIELDS WITHIN PROPOSED DEVELOPMENT AREA

Field A-1, from W

Field A-2, from E

Field A-3, from W

Field A-4, from S



Field A-5, from N

Field A-6, from W

Field A-7, from W

Field A-8, from S

Field A-9, from S


Field A-10, from N


Field A-11, from N


Fields A-12 and A-13, from W


Field A-14, from N


Field A-15, from N


Field A-16 from N


Field A-17 From S

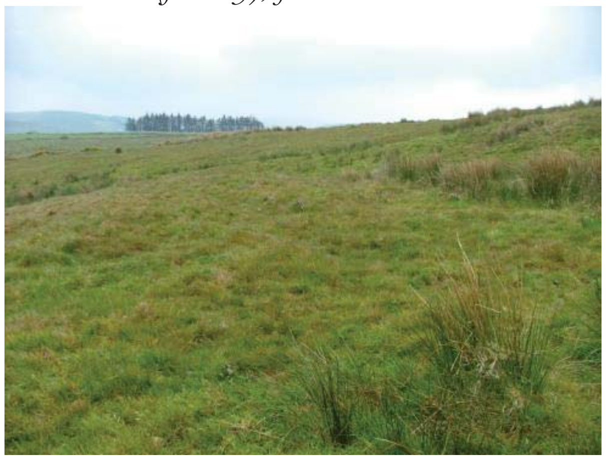

Field A-18, from S


Field A-19, from N

Field A-20 (forestry), from NE

Field A-21, from E

Field A-22 and A-23, from E



Field A-24, from S

Field A-25, from E

Field A-26, from S

Field A-27, from SW

Field A-28, from N

Field B-1 (forestry), from S

Field B-2, from S

Field B-3, from S

Field B-4 from S

Field B-5, from NW

Field B-6, from W

Field B-7, from S

Field B-8, from S

Field B-9, from S

Field B-10, from SE

Field B-11, from E

Field B-12, from W

Field B-13, from E

Field B-14, from N

Field B-15, from S

Field B-16, from SW

Field B-17, from SW

Field B-18, from N

Field B-19, from W

Field B-20, from SW

Field B-21, from SW

Field B-22, from NE

Field B-23, from W

Field B-24 from SW

Field B-25, from W

Field B-26, from W

Field B-27, from N


Field B-28 from NE


Field B-29, from E


Field B-30, from N


Field B-31, from N


Field B-32, from W


Field B-33, from W


Field B-34, from E


Field B-35, from N


Field B-36, from N

Field C-1, from N

Field C-2, from S

Field C-3 (background), from NW

Field C-4 and C-5, from S

Field C-6, from SW

Field C-7, from NW

Field C-8 (forestry), from N

Field C-9, from NW

Field C-10, from SE

Field C-11, from SW

Field C-12, from W

Field C-13, from N

Field C-14, from NE

Field C-15, from NW

Field C-16 and C-17, from N

Field C-18 and C-19 from, SE

Field C-20, from SE

Field C-21, from SE


Field C-22 from S


Field C-23 from S


Field C-24, from S


Field C-25 from NW


Field C-26 from SW


Field D-1 from N


Field D-2(forestry), from W

APPENDIX 12-IV: PHOTOGRAPHS OF WIND TURBINE FOOTPRINTS WITHIN PROPOSED DEVELOPMENT AREA


Turbine 1, from E


Turbine 2, from E


Turbine 3, from N


Turbine 4, from E


Turbine 5, from NW


Turbine 6, from E


Turbine 7, from S


Turbine 8, from N


Turbine 9, from E


Turbine 10, from NW


Turbine 11, from W


Turbine 12, from N


Turbine 13, from N


Turbine 14, from E


Turbine 15, from S


Turbine 16, from N


Turbine 17, from SW


Turbine 18, from SW

Turbine 19 (in forestry), from NE

Turbine 20 from NW

Turbine 21, from N

Turbine 22, from W

Malachy Walsh and Partners
Engineering and Environmental Consultants

CHAPTER 13
ECOLOGICAL IMPACT ASSESSMENT

UPPERCHURCH WINDFARM

MWP ENVIRONMENT AND PLANNING

Engineering and Environmental Consultants

13 Ecology Impact Assessment

13.1 INTRODUCTION

This chapter describes the ecology of the proposed Upperchurch development site, with emphasis on habitats, flora, fauna and water quality, and assesses the potential effects of the proposed windfarm development on these ecological receptors. The proposal is to construct a 22 Turbine wind farm 1.9 km west of Upperchurch in county Tipperary. An Appropriate Assessment has also been undertaken for the site and is presented in **Appendix 13-II** of this chapter.

This ecological impact assessment was carried out with regard to the following publications:

- Guidelines on the information to be contained in Environmental Impact Statements (EPA, 2002);
- Guidelines for Ecological Impact Assessment in the United Kingdom published by the Institute of Ecology and Environmental Management (IEEM, 2006); and
- Environmental Assessment and Construction Guidelines (NRA, 2009).

13.1.1 Scope of Assessment

The specific objectives of the study were to:

- Undertake a baseline ecological survey of the site and evaluate the nature conservation importance of the site;
- Assess the direct, indirect and cumulative ecological implications or impacts of the project during its lifetime;
- Where possible propose mitigation measures to remove or reduce those impacts at the design and construction stage; and
- Achieve the best possible biodiversity outcome from a change in current land use.

13.1.2 Study objectives

The specific objectives of the study were to:

- Undertake a baseline ecological survey of the Upperchurch Windfarm Site and evaluate the nature conservation importance of the site;
- Assess the construction, operational and cumulative ecological implications or impacts of the project during its lifetime;
- Where possible propose mitigation measures to remove or reduce those impacts at the design and construction stage; and
- Achieve the best possible biodiversity outcome from a change in current land use.

13.1.3 Methodology

This section details the steps and methodology employed to undertake an ecological impact assessment of the proposed Upperchurch Windfarm.

13.1.3.1 Desk study

A desk study was carried out to collate and review available information, datasets and documentation sources pertaining to the sites natural environment. Some of these sources included:

- OSI Aerial photography and 1:50000 mapping;
- National Parks and Wildlife Service (NPWS);
- New Atlas of the British and Irish Flora (Preston *et al.* 2002);
- Irish Red Data Book for Vascular Plants (Curtis and McGough, 1988);
- Teagasc Soil area maps;
- Geological Survey Ireland (GSI) area maps;
- Environmental Protection Agency (EPA) water quality data; and
- Shannon International River Basin District (ShIRBD) and the South Eastern River Basin District (SERBD) datasets (Water Framework Directive).

13.1.3.2 Habitat surveying, mapping and evaluation

The field surveys were conducted by ecologists during the month of June 2012. Habitats were categorised according to the Heritage Council's '*A Guide to Habitats in Ireland'* (Fossitt, 2000) to level 3.

The habitat mapping exercise had regard to the 'Best Practice Guidance for Habitat Survey and Mapping' (Smith *et al.* 2010) published by the Heritage Council. Laminated A3 aerial photography was used together with a GPS to accurately enable field navigation. Habitat categories, characteristic plant species and other ecological features and resources were recorded on waterproof field sheets.

Scientific and common names for plants follow Parnell *et al*. (2012) and Blamey *et al.* (1996), respectively. In addition to habitat identification, each habitat was assessed for its ecological significance, based on the National Roads Authority (NRA) Site Evaluation Scheme (NRA, 2009) (see section 13.1.4 below).

Habitat boundaries and associated attribute data were mapped using desk-based GIS software, namely ArcView 9.2, which was also used to calculate habitat areas and lengths.

Once the baseline ecological survey and mapping was complete, a constraints map highlighting important ecological features and resources was generated, indicating areas for preclusion from the final windfarm infrastructure layout. The ecological constraints map was used to design a windfarm layout with the least ecological impact.

13.1.3.3 Biological water quality and aquatic habitat assessment

Biological water quality monitoring refers to Q Value system of ranges where the relationship between water quality and the in-stream macroinvertebrate community is described in numerical terms. A Q value of 5 indicates very high water quality while a Q value of 1 indicates poor water quality.

TABLE 13-1: RELATIONSHIP BETWEEN BIOTIC INDEX (Q-VALUE) AND WATER QUALITY.

Biotic Index	EPA Water Quality	Water Framework Directive Ecological Status	Quality Status
Q5	Good	High	Unpolluted Waters
Q4-5	Fair - Good	High	
Q4	Fair	Good	
Q3-4	Doubtful - Fair	Moderate	Slightly Polluted Waters
Q3	Doubtful	Poor	Moderately Polluted Waters
Q2-3	Poor - Doubtful	Poor	
Q2	Poor	Bad	Seriously Polluted Waters
Q1-2	Bad - Poor	Bad	
Q1	Bad	Bad	

Kick sampling, where the river bed is disturbed using the foot immediately upstream of a kick net, which collects the sample, was conducted at six sampling stations just downstream of the study area. Macroinvertebrate samples were returned to the laboratory where species within each kick sample were identified to genus level. Differing macroinvertebrate species are assigned to a group according to its tolerance of or sensitivity to water pollution. A river is then assigned a Q value based on these groupings.

13.1.3.4 Bat survey

Surveys were conducted by ecologists on the night of 21st of June 2012 throughout the study area. Potentially important features for bats including mature trees, waterways, hedgerows, stonewalls and buildings were studied extensively for potential bat activity. Bat surveys were conducted along transect routes using a Frequency Division AnaBat Detector System (AnaBat SD2 Flash Card Bat Detector). Frequency Division is a technique used to convert the inaudible bat echolocation calls to audible sounds. The AnaBat unit also uses Zero-Crossing Analysis (ZCA) to make the real-time recorded calls visible for display purposes. It is these sonograms (2-d sound pictures) that are digitally stored on the CF card and downloaded for analysis. Each time a bat is detected, an individual time-stamped (date and time to the second) file is recorded. Evidence of bat roosts were searched for and information on all potential roosts shall be recorded according to roost identification guidelines '*Bat Survey Guidelines: Traditional Farm Buildings Scheme*', Aughney, T., Kelleher, C. & Mullen, D. (2008).

When investigating potential bat roosts best practise methodology referred to in *NRA Guidelines for the Treatment of Bats During Construction of National Road Schemes,* (2005) was implemented.

13.1.3.5 Ornithological surveys

Winter Hen Harrier Survey 2010/2011

Field surveys were undertaken at the proposed site in order to examine the usage and activity of hen harriers at the site during the winter of 2010/2011.

Vantage Point Observations

Vantage point observations were carried out in order to assess the level of raptor activity and purpose at the development site. These observations were carried out in accordance with NPWS hen harrier survey guidelines. Three (3) vantage point locations were selected in order to obtain maximum visibility of the site and habitats outside the site boundary.

Vantage point watches were of six (6) hours duration and the three vantage points were watched for a total of eighteen (18) hours per site visit. During the course of the survey from November 2010 to March 2011 the site was watched for a total of ninety (90) hours. The locations of the vantage points are illustrated in **Figure 13-7** at the end of this report.

Summer Hen Harrier Survey 2011

Vantage Point Observations

Vantage point observations were carried out in order to assess the level of raptor activity and purpose at the development site during the summer of 2011. These observations were carried out in accordance with NPWS hen harrier survey guidelines. The vantage point locations chosen for the summer hen harrier survey remained the same as those chosen for the winter hen harrier survey.

Vantage point watches were of six (6) hours duration and the three vantage points were watched for a total of eighteen (18) hours per site visit. During the course of the summer survey from April to July 2011 the site was watched for a total of seventy two (72) hours. The locations of the vantage points are illustrated in **Figure 13-7** at the end of this report.

Transect surveys

Winter Transect counts were undertaken on 19th January and 16th March 2011 at five locations across the site and their locations are illustrated in **Figure 13-8** at the end of this report. Transect counts were undertaken on 19th May and 12th July 2011 at the same five locations as the winter bird survey.

13.1.3.6 Mammal survey

A mammal survey of the site was carried out in conjunction with the habitat survey, which concentrated on protected species such as badger, Irish (mountain) hare, otter and red squirrel. The site was searched for tracks and signs of mammals.

13.1.3.7 Other fauna

During the course of the habitat survey at the proposed Upperchurch Windfarm site, other species of fauna were noted and included in the report.

13.1.4 Habitat and Species Evaluation

The value of the ecological resources and features or receptors was determined using the ecological evaluation guidance given in the National Roads Authority (NRA) Ecological Assessment Guidelines as outlined in Table 13.2 (NRA, 2009).

This evaluation scheme seeks to provide value ratings for ecological receptors, with values ranging from internationally to locally important. Internationally important receptors would include candidate Special Areas of Conservation (cSAC) or Special Protected Areas (SPA) while those of national importance would include Natural Heritage Areas (NHA).

This evaluation scheme is aimed at assessing the value of sites (see Table 13-2). It has been adapted here to assess the value of habitats and fauna within one site. The value of habitats is assessed based on its condition, size, rarity, conservation and legal status. The value of fauna is assessed on its biodiversity value, legal status and conservation status. Biodiversity value is based on its national distribution, abundance or rarity, and associated trends.

All Irish bat species are protected under the Wildlife (Amendment) Act 2000 and the EU Habitats Directive.

Some of the habitats and species identified were selected as key ecological receptors. The NRA (NRA, 2009) refer to key ecological receptors as those ecological features which are evaluated as Locally Important (higher value) or higher and are likely to be impacted significantly by the proposed development. The features that were evaluated as being of Local Importance (higher value) and higher in this study were selected as key ecological features and the impact significance on each of these features was assessed.

TABLE 13-2: EXAMPLES OF VALUATION AT DIFFERENT GEOGRAPHICAL SCALES (SOURCE NRA, 2009)

International Importance	• 'European Site' including Special Area of Conservation (SAC), Site of Community Importance (SCI), Special Protection Area (SPA) or proposed Special Area of Conservation.
	• Proposed Special Protection Area (pSPA).
	• Site that fulfils the criteria for designation as a 'European Site' (see Annex III of the Habitats Directive, as amended).
	• Features essential to maintaining the coherence of the Natura 2000 Network.[1]
	• Site containing 'best examples' of the habitat types listed in Annex I of the Habitats Directive.
	• Resident or regularly occurring populations (assessed to be important at the national level)[2] of the following:
	  • Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive;
	  and/or
	  • Species of animal and plants listed in Annex II and/or IV of the Habitats Directive.
	• Ramsar Site (Convention on Wetlands of International Importance Especially Waterfowl Habitat 1971).
	• World Heritage Site (Convention for the Protection of World Cultural & Natural Heritage, 1972).
	• Biosphere Reserve (The Biosphere Programme & UNESCO Man).
	• Site hosting significant species populations under the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals, 1979).
	• Site hosting significant populations under the Berne Convention (Convention on the Conservation of European Wildlife and Natural Habitats, 1979).
	• Biogenetic Reserve under the Council of Europe.
	• European Diploma Site under the Council of Europe.
	• Salmonid water designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988, (S.I. No. 293 of 1988).[3]

National Importance	• Site designated or proposed as a Natural Heritage Area (NHA). • Statutory Nature Reserve. • Refuge for Fauna and Flora protected under the Wildlife Acts. • National Park. • Undesignated site fulfilling the criteria for designation as a Natural Heritage Area (NHA); • Statutory Nature Reserve; Refuge for Fauna and Flora protected under the Wildlife Act; and/or a National Park. • Resident or regularly occurring populations (assessed to be important at the national level)[4] of the following: • Species protected under the Wildlife Acts; and/or • Species listed on the relevant Red Data list. • Site containing 'viable areas'[5] of the habitat types listed in Annex I of the Habitats Directive.

County Importance	• Area of Special Amenity.[6]
	• Area subject to a Tree Preservation Order.
	• Area of High Amenity, or equivalent, designated under the County Development Plan.
	• Resident or regularly occurring populations (assessed to be important at the County level)[7] of the following:
	  • Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive;
	  • Species of animal and plants listed in Annex II and/or IV of the Habitats Directive;
	  • Species protected under the Wildlife Acts; and/or
	  • Species listed on the relevant Red Data list.
	• Site containing area or areas of the habitat types listed in Annex I of the Habitats Directive that do not fulfil the criteria for valuation as of International or National importance.
	• County important populations of species, or viable areas of semi-natural habitats or natural heritage features identified in the National or Local BAP,[8] if this has been prepared.

	• Sites containing semi-natural habitat types with high biodiversity in a county context and a high degree of naturalness, or populations of species that are uncommon within the county. • Sites containing habitats and species that are rare or are undergoing a decline in quality or extent at a national level.

Locally Important (higher level)	• Locally important populations of priority species or habitats or natural heritage features identified in the Local BAP, if this has been prepared;
	• Resident or regularly occurring populations (assessed to be important at the Local level)[9] of the following:
	  • Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive;
	  • Species of animal and plants listed in Annex II and/or IV of the Habitats Directive;
	  • Species protected under the Wildlife Acts; and/or
	  • Species listed on the relevant Red Data list.
	• Sites containing semi-natural habitat types with high biodiversity in a local context and a high degree of naturalness, or populations of species that are uncommon in the locality;
	• Sites or features containing common or lower value habitats, including naturalised species that are nevertheless essential in maintaining links and ecological corridors between features of higher ecological value

Locally Important (lower level)	• Sites containing small areas of semi-natural habitat that are of some local importance for wildlife; • Sites or features containing non-native species that are of some importance in maintaining habitat links.

[1] See Articles 3 and 10 of the Habitats Directive.
[2] It is suggested that, in general, 1% of the national population of such species qualifies as an internationally important population. However, a smaller population may qualify as internationally important where the population forms a critical part of a wider population or the species is at a critical phase of its life cycle.
[3] Note that such waters are designated based on these waters' capabilities of supporting salmon (*Salmo salar*), trout (*Salmo trutta*), char (*Salvelinus*) and whitefish (*Coregonus*).
[4] It is suggested that, in general, 1% of the national population of such species qualifies as a nationally important population. However, a smaller population may qualify as nationally important where the population forms a critical part of a wider population or the species is at a critical phase of its life cycle.
[5] A 'viable area' is defined as an area of a habitat that, given the particular characteristics of that habitat, was of a sufficient size and shape, such that its integrity (in terms of species composition, and ecological processes and function) would be maintained in the face of stochastic change (for example, as a result of climatic variation).
[6] It should be noted that whilst areas such as Areas of Special Amenity, areas subject to a Tree Preservation Order and Areas of High Amenity are often designated on the basis of their ecological value, they may also be designated for other reasons, such as their amenity or recreational value. Therefore, it should not be automatically assumed that such sites are of County importance from an ecological perspective.
[7] It is suggested that, in general, 1% of the County population of such species qualifies as a County important population. However, a smaller population may qualify as County important where the population forms a critical part of a wider population or the species is at a critical phase of its life cycle.
[8] BAP: Biodiversity Action Plan
[9] It is suggested that, in general, 1% of the local population of such species qualifies as a locally important population. However, a smaller population may qualify as locally important where the population forms a critical part of a wider population or the species is at a critical phase of its life cycle.

13.1.5 Assessing Impact Significance

Once the value of the identified ecological receptors (features and resources) was determined the next step was to assess the potential effect or impact of the proposed windfarm on the identified key ecological receptors. This was carried out with regard to the criteria outlined in various impact assessment guidelines (NRA, 2009; IEEM, 2006). The impacts were assessed under a number of parameters such as magnitude, extent, duration and reversibility.

In line with the EPA Guidelines (EPA, 2002), the following terms are defined when quantifying duration:

- Temporary: up to 1 year
- Short-term: from 1-7 years;
- Medium-term: 7-15 years;
- Long-term: 15-60 years; and
- Permanent: over 60 years.

Confidence levels of the impact predictions were also given based on the 4 point scale as given in both the IEEM (2006) and NRA (2009) guidelines. See Table 13-3 below.

TABLE 13-3: CONFIDENCE LEVELS OF PREDICTIONS OF IMPACTS AS OUTLINED IN NRA (2009) AND IEEM (2006).

Confidence level category	
Near certain	>95% chance of occurring as predicted
Probably	50-95% chance of occurring as predicted
Unlikely	5-50% chance of occurring as predicted
Extremely unlikely	<5% chance of occurring as predicted

Where impacts are assessed to be significant, mitigation measures have been incorporated into the project design to remove or reduce these impacts. The residual impacts after mitigation were then assessed.

The cumulative impact of the windfarm development was also assessed by discussing the impact of the windfarm in terms of other developments that have planning permission, that are under construction or are in existence in the area. The cumulative impact of forestry, agriculture and peat extraction practices in the greater area are also considered.

13.2 EXISTING ENVIRONMENT

13.2.1 Site Overview and Water Quality

The proposed Upperchurch Windfarm site is located in north Co. Tipperary, approximately 1.9 km west of the village of Upperchurch and a further 18 km west of Thurles town. The study area is made up of four sections with an overall area of 12 km².

The soil types found in the study area mostly surface water gleys / ground water gleys acidic in the lower areas and lithosols / regosols in the higher areas. Patches of podzols peaty, peaty gleys acidic and surface water gleys / ground water gleys shallow are found on the site.

The surrounding local landscape is dominated by 'Pasture' with 'Forestry, 'Bog', 'Other Agricultural Land' and 'Other' land located to the south of the proposed windfarm site (NPWS, online mapping 2012). The area is underlain by Silurian Metasediments and Volcanics with subsoils consisting of "Sandstone and shales till Devonian/Carboniferous"

The four sections of the site are located on a series of small hills or drumlins that reach elevations between 363mOD and 411mOD where the peaks are generally at heights of 100m above the intervening lower terrain. The highest peak is that of Knockmaroe at an elevation of 411mOD.

A large proportion of the site is within the South Eastern River Basin District and drains to the southeast into the Owenbeg and Turraheen Rivers and ultimately to the River Suir. The site is drained to the north by the Clodiagh River of which the Owenbeg is a tributary. The remaining part of the site at the south western extremity lies within the Shannon River Basin District and drains to the Aughvana River and ultimately to the Mulkear River.

The area originally would have had a shallow peat land cover but most of it has been reclaimed by deep ploughing and converted to pasture. The remaining peat areas are used mainly for commercial forestry. Some rock outcropping occurs, most notably at the northeast part of the site.

13.2.2 Designated Sites

13.2.2.1 Sites of International Importance

Candidate Special Areas of Conservation (cSACs) are protected under the European Union (EU) 'Habitats Directive' (92/43/EEC), as implemented in Ireland by the European Communities (Natural Habitats) Regulations, 1997. There are four cSACs within 10km of the proposed Upperchurch windfarm (see **Figure 13-1** below).

Special Protection Areas (SPAs) were initially designated under Directive 79/409/EEC, The Directive on the Conservation of Wild Birds ('The Birds Directive'), and are now protected as Natura 2000 Sites under the EU 'Habitats Directive'. There is one SPA within 10km of the study area (see **Figure 13-2** below).

13.2.2.2 Sites of National Importance

Sites of National Importance in the Republic of Ireland are termed, Natural Heritage Areas (NHA) and proposed Natural Heritage Areas (pNHA). While the Wildlife (Amendment) Act 2000 has been passed into law, pNHAs will not have legal protection until the consultative process with landowners has been completed; this process is currently ongoing. One NHA and five pNHAs were recorded within 10km of the Study Area (see **Figure 13-3** below).

Table 13-4 presents details of the key ecological features of these sites, and gives their distance and direction from the study area.

TABLE 13-4: DESIGNATED SITES LOCATED WITHIN 10KM OF THE STUDY AREA (REFER TO FIGURES 13-1, 13-2 AND 13-3 FOR SITE LOCATIONS).

Name	Site Code	Key Features	Distance (and direction) of the designated site from the proposed windfarm
Lower River Shannon cSAC	002165	Freshwater pearl mussel (*Margaritifera margaritifera*) [1029] Sea lamprey (*Petromyzon marinus*) [1095] Brook lamprey (*Lampetra planeri*) [1096] River lamprey (*Lampetra fluviatilis*) [1099] Salmon (*Salmo salar*) [1106] Sandbanks which are slightly covered by sea water all the time [1110] Estuaries [1130] Mudflats and sandflats not covered by seawater at low tide [1140] Coastal lagoons [1150] Large shallow inlets and bays [1160] Reefs [1170] Perennial vegetation of stony banks [1220] Vegetated sea cliffs of the Atlantic and Baltic coasts [1230] *Salicornia* and other annuals colonizing mud and sand [1310] *Spartina* swards (*Spartinion maritimae*) [1320] Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330] Bottle-nosed dolphin (*Tursiops truncatus*) [1349] Otter (*Lutra lutra*) [1355] Mediterranean salt meadows (*Juncetalia maritimi*) [1410] Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation [3260] Molinia meadows on calcareous, peaty or clavey-silt-laden soils (*Molinion caeruleae*) [6410] Alluvial forests with *Alnus glutinosa* and Fraxinus excelsior (*Alno-Padion*, *Alnion incanae*, *Salicion albae*) [91E0]	2.7km west of the proposed windfarm site.
Bolingbrook Hill cSAC	002124	Northern Atlantic wet heaths with *Erica tetralix* [4010] European dry heaths [4030] Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and submountain areas, in continental Europe) [6230]	6.9km north west of the proposed windfarm site.

Name	Site Code	Key Features	Distance (and direction) of the designated site from the proposed windfarm
Lower River Suir cSAC	002137	Freshwater pearl mussel (*Margaritifera margaritifera*) [1029] White-clawed crayfish (*Austropotamobius pallipes*) [1092] Sea lamprey (*Petromyzon marinus*) [1095] Brook lamprey (*Lampetra planeri*) [1096] River lamprey (*Lampetra fluviatilis*) [1099] Allis shad (*Alosa alosa*) [1102] Twaite shad (*Alosa fallax fallax*) [1103] Salmon (*Salmo salar*) [1106] Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330] Otter (*Lutra lutra*) [1355] Mediterranean salt meadows (*Juncetalia maritimi*) [1410] Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation [3260] Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels [6430] Old sessile oak woods with *Ilex* and *Blechnum* in British Isles [91A0] Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*) [91E0] *Taxus baccata* woods of the British Isles [91J0]	2.8km east of the proposed windfarm site. 4.1km downstream of the proposed windfarm site.
Anglesey Road cSAC	002125	Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe) [6230]	2.55km south of the proposed windfarm site.
Slievefelim to Silvermines Mountains SPA	004165	Hen Harrier (*Circus cyaneus*) [A082]	Directly adjacent to the western boundary of windfarm site.
Mauherslieve Bog NHA	002385	Peatland [T010]	4.6km west of the proposed windfarm site.
Bilboa and Gortnageragh River Valleys pNHA	001851	The pNHA is located within the Lower River Shannon SAC and part of the Slievefelim to Silvermines Mountains SPA. There is no site synopsis available for this pNHA.	9.3km south west of the windfarm site.
Killavalla Wood pNHA	001178	Planted woodland with natural characteristic at present/ typical ground flora with some exotic species.	8.6km north of the proposed windfarm site.
Nenegh River Gorge pNHA	001133	Woodland/ grassland/ rich mosaic of unimproved semi-natural Habitats.	5km northwest of the proposed windfarm site.
Aughnaglanny Valley pNHA	000948	Semi-natural woodland in a steep-sided river/dry and wet broad-leaved woodland, humid grassland and scrub/ marshland/Red Squirrel and Fox/ woodland bird sps/ecological, botanical, zoological and ornithological interest	5.9km south of the proposed windfarm site.
Inchinsquillib and Dowling's Woods pNHA	000956	The site is located within the Lower Suir SAC. There is no site synopsis available for this pNHA.	8.7km southwest of the proposed windfarm site.

An Appropriate Assessment was undertaken to assess the potential impacts to the integrity of Natura 2000 Sites (SACs and SPAs) that might arise from the proposed development. This was done in accordance with Article 6 of the 'Habitats' Directive (92/43/EEC) and is presented in **Appendix 13-II** of this chapter.

13.2.2.3 Additional Sites

There are no Nature Reserves, Important Bird Areas (IBAs) or Ramsar sites within 10km of the study area.

13.2.3 Habitat Descriptions of the Proposed Upperchurch Development Site

This section describes the habitats recorded within the site boundary during the habitat survey. These habitats have been classified according to (Fossitt, 2000) and are described in detail in the following sections. A total of thirteen habitats have been identified within the proposed Upperchurch Windfarm site. The main habitats within the site are improved agricultural grassland, acidic grassland and conifer plantation. A list of species recorded from each habitat is presented in Table 13-5.

The site can be described as supporting a small amount of wet habitats such as wet heath and upland blanket bog with both often generally on higher ground and some on gentler lower slopes. There is evidence of where peat cutting has taken place in the past. Extensive land reclamation has taken place throughout the site where often these areas encroach into the wet heath, upland blanket bog and acidic grassland. Cattle grazing also influence the habitats types within the site often causing transitions between sites and creating mosaics of different habitat types. Grassland habitats include improved agricultural and acid grassland associated with present and past agricultural activity. Blocks of conifer plantation occur within the site. These consist of mature conifer plantations to just recently planted areas.

The habitat map is presented at the end of this chapter (see **Figures 13-4 Map 1, Map 2** and **Map 3**). Photographic plates are presented in **Appendix 13-I** of this chapter. Table 13-5 lists the identified habitats within the site that are described in the following sections. Table 13-6 lists identified habitat mosaics.

TABLE 13-5: LIST OF IDENTIFIED HABITATS FROM HABITAT SURVEY AT THE PROPOSED UPPERCHURCH SITE.

Habitat	**Habitat code**	**Spatial description within site**
Improved agricultural grassland	GA1	The most dominant habitat type within the site.
Wet grassland	GS4	Infrequent throughout the study area with the most extensive section to the north east of turbine T8.
Wet heath	HH3	Formed a mosaic with upland blanket bog with a section north west of turbine T2.
Acid grassland	GS3	This habitat occurs to the south east of turbines T3 and T4 and on steep slopes to the northwest of turbine T21.
Upland blanket bog	PB2	There are four small sections of upland blanket within the proposed site.
Conifer plantation	WD4	Occurs in all four sections of the proposed site.
Upland/eroding rivers and streams	FW1	A network of streams within the greater area drains the site. There are three waterways flowing within the site boundary. An unnamed stream drains to the southeast, approx. 200m to the north of T4. An unnamed stream drains to the south 60m southwest of T1. Another stream originates just inside the site boundary of the north eastern section at the southern end of this section, approximately 600m to the south of T9.

Habitat	Habitat code	Spatial description within site
Hedgerows	WL1	The dominant type for field boundary found in all four sections.
Drainage ditches	FW4	This habitat occurs to the east of turbine T7 flowing in a northerly direction.
Spoil and bare ground	ED2	There are farm buildings, tracks, and a farm yard located to the southeast of the turbine T18. There are several roads and farm tracks throughout the site which would also fall into this category.
Buildings and artificial surfaces	BL3	This category has been used to describe farm buildings, tracks, and a farm yard located to the southeast of the turbine T18. There are several roads and farm tracks throughout the site which would also fall into this category.
Treelines	WL2	Limited mainly to areas where the site bounds tree-lined roads, with very little of this habitat occurring within the site.
Neutral grassland	GS1	An area of land to the northwest of turbine T22, to the west of the conifer plantation is fenced off and is not managed as agricultural grassland.

TABLE 13-6: MOSAICS IDENTIFIED WITHIN THE STUDY AREA.

Habitat Mosaic	Habitat code
Mosaic of Improved Grassland & Wet Grassland	GA1 / GS4
Mosaic Wet Heath & Upland Blanket Bog	HH3 / PB3
Mosaic Upland Blanket Bog & Acidic Grassland	PB3 / GS3

13.2.4 Habitat Descriptions of Proposed Upperchurch Windfarm Site

13.2.4.1 Improved agricultural grassland (GA1)

This is the dominant habitat type within the proposed Upperchurch Windfarm site, and would be regarded as relatively high intensity in terms of management. These include areas that have been highly modified by man, which include areas that have been reclaimed where reseeding has occurred and would be regularly fertilised. Many of the fields were heavily grazed and harvested for silage. Evidence of both practises was observed during surveying. Typically Improved grassland habitats are species-poor with rye-grasses (*Lolium spp*.) being the dominant sward. A variety of grasses occurred throughout the site which included Yorkshire fog (*Holcus lanatus*), crested dog's-tail (*cynosures cristatus*), false oat-grass (*Arrhenatherum elatius*), meadow foxtail (*Alopecurus pratensis*) and particularly sweet vernal grass (*Anthoxanthum odoratum*) with perennial ryegrass (*Lolium perenne*) not very abundant. Common herbs include meadow buttercup (*Ranunculus arcis*), ribwort plantain (*Plantago lanceolata*), common ragwort (*Senecio jacobaea*) and common mouse-ear (*Cerastium fontanum*).

These habitats are more species rich towards the periphery along the margins and in drainage areas. Some species included foxglove (*Digitalis purpure*), soft rush (*Juncus effuses*), cuckoo flower (*Cardamine pratensis*) and ragged robin (*Lychnis viscaria*).

13.2.4.2 Wet Grassland (GS4)

This habitat occurs along the lower lying areas in the location of turbine T8. This habitat continues to the southeast along the bank of the unnamed stream. This habitat also occurs in the proximity of turbine T6. Species composition varied considerably within these wet grassland habitats. Species typical of wet grassland habitat that occur here include rush (*Juncus spp.*), with approximately eighty percent cover in some areas, such as compact rush (*Juncus conglomerates*), soft rush (*Juncus effusus*) and hard rush (*Juncus inflexus*). Outside of the *Juncus* dominant areas, grass species had an approximate cover of sixty percent which included Yorkshire fog (*Holcus lanatus*), sweet vernal grass (*Anthoxanthum odoratum*), with the occasional observations of purple moor-grass (*Molinia caerulea*), red fescue (*Festuca rubra*) and meadow foxtail (*Alopecurus pratensis*) towards the dryer areas. Mixed through these grass species include an approximate cover of forty percent cover of broadleaf herbs such as creeping buttercup (*Ranunculus repens*), spearwort (*Ranculus flammula*), meadowsweet (*Filipendula ulmaria*), cuckoo flower (*Cardamine pratensis*), marsh thistle (*Cirsium palustre*), marsh bedstraw (*gallium palustre*), red clover (*Trifolium pratense*), common ragwort (*Senecio jacobaea*) and broad-leaved dock (*Rumex obtusifolius*).

13.2.4.3 Wet heath (HH3)

This category is described by Fossitt (2000) as supporting vegetation with at least 25% cover of dwarf shrubs but can also be dominated by purple moor-grass (*Molinia caerulea*). The wet heath within the site has been damaged by overgrazing and the soils are quite shallow and relatively dry. Hence, the wet heath is not in optimal condition. However, an area just to the northwest of Turbine T2 supports a relatively good diversity of flora with a good representation of the typical species for this habitat. The vegetation is dominated by bell heather (*Erica cinerea*), purple moor-grass (*Molinia caerulea*), with cross-leaved heath (*Erica tetralix*) occasional. Other common species included heath rush (*Juncus squarrosus*), tormentil (*Potentilla erecta*) and sedges (*Carex* spp.) are frequent and *Cladonia* lichens occur occasionally.

13.2.4.4 Acid grassland (GS3)

This habitat occurs mainly outside of the enclosed grassland farm areas and in areas where no reclamation has taken place, but is extensively grazed by cattle. Often this habitat grades into or forms mosaics with the other habitats where cattle grazing takes place. This habitat occurs to the south east of turbines T3 and T4 and on steep slopes to the northwest of turbine T21. Some species recorded that characterise this habitat include sweet vernal grass (*Anthoxanthum odoratum*), a light scattering of purple moor-grass (*Molinia caerulea*), heath bedstraw (*Galium saxatile*), tormentil (*Potentilla erecta*) which was very common and yarrow (*Achillea millefolium*).

13.2.4.5 Upland Blanket Bog (PB2)

It was clear from the ecological survey that the extent of upland blanket bog habitat within the site boundary and the greater area was greater historically. Both the quality and extent of this habitat has been significantly reduced by peat-cutting and agricultural land management practises including drainage, grazing, fertilising and reseeding. A section of good quality upland blanket bog was recorded to the north of turbine T12 and T13. There was some evidence of infrequent grazing within the habitat by cattle but this was very localised and not abundant.

Species recorded within the habitat included bell heather (*Erica cinerea*), common heather (*Calluna vulgaris*), purple moor-grass (*Molinia caerulea*), heath bedstraw (*Galium saxatile*), tormentil (*Potentilla erecta*), devils-bit scabious (*Succisa pratensis*), deer-grass (*Trichophorum cespitosum*), star sedge (*Carex echinata*), glaucous sedge (*Carex flacca*) and cotton grass (*Eriophorum vaginatum*). An open area of peatland occurs to the north of turbine T19 (GPS location: 93382 61205) within the western section of the Proposed Upperchurch Site. This area is surrounded by improved agricultural grassland to the north, west and south and by conifer plantation to the east and has an average bank height of approximately 1.2 meters. At this particular area bell heather (*Erica cinerea*) has a cover of approximately 65%. Another section of upland blanket bog was recorded just to the west of turbine T3 on a plateau with an average bank height of approximately 1.5 meters and covers an area of approximately 500m^2. Most of the blanket bog is limited to the higher areas with shallow peat depth. Species included purple moor-grass (*Molinia caerulea*), cotton grass (*Eriophorum vaginatum*), tormentil (*Potentilla erecta*), bilberry (*Vaccinium myrtillus*) and with a low percentage cover of sphagnum moss species.

13.2.4.6 Conifer Plantation (WD4)

Commercial conifer plantation occurs in all four sections of the proposed site. These plantations are predominantly of sitka spruce (*Picea sitchensis*) and the odd scattering of larch species (*Larix* spp.). Some of these plantations have margins of alder (*Alnus glutinosa*), common ash (*Fraxinus excelsior*) and downy birch (*Betula pubescens*) that are up to six trees deep on the road side of these plantations. The ground flora is sparse under mature stands where the ground is covered in a layer of decaying pine needles with a little cover of mosses including *Sphagnum* spp., *Thuidium tamariscinum* and *Rhytidiadelphus* spp. In areas of less mature forestry, the ground layer vegetation is more representative of a wet heath and upland blanket bog habitat with species including bell heather (*Erica cinerea*), purple moor-grass (*Molina caerulea*), deergrass (*Trichophorum caespitosum*), and sedges (*Carex spp*.).

13.2.4.7 Upland/Eroding Rivers and Streams (FW1)

Three small, first order streams streams occur within the site. A stream drains to the southeast parallel to the boundary of the south eastern section approximately 200m to the north/north east of T4. A small shallow stream drains to the south, 60m to the southwest of T1. A small stream originates just inside the boundary of the north eastern section, approximately 600m to the south of T9. The greater area is drained by a network of streams and rivers which ultimately drain to the Lower River Suir to the south east and to the Lower River Shannon to the west. The Turraheen, Owenbeg and Clodiagh Rivers form part of the South Eastern River Basin District and ultimately join the River Suir to the southeast. The Aughvana River, which is part of the Shannon International River Basin District, joins the Mulkear River to the south west. A detailed description of the streams draining the study area is presented in section 13.2.9 below.

13.2.4.8 Hedgerow (WL1)

A number of hedgerows occur within the site marking field boundaries. The hedgerows varied from more diverse higher quality hedgerows to more species poor sections to stretches that varied in vegetation height and cover. Towards the centre of the western section hedgerows were described as grass dominated ditches. Other dominant species within the hedgerows include bramble (*Rubus fruticosus*), gorse (*Ulex europaeus*), willows (*Salix spp.*) and a thick fuchsia (*Fuchsia magellancia*) hedge was recorded along the western boundary of the western section. Other species included bilberry (*Vaccinium myrtillus*), nettle (*Urtica dioica*) and male fern (*Dryopteris filix-mas*). Occasional trees (some saplings) occur along the hedgerows which include sycamore (*Acer pseudoplatanus*) and oak (*Quercus robur*).

13.2.4.9 Drainage Ditches (FW4)

There was a small network of manmade drainage ditches around the edges of both the wet and improved agricultural grassland fields throughout most of the site. This habitat occurs to the east of turbine T7 flowing in a northerly direction. This had a relatively moderate flow which drained water from the conifer plantation to the south to an unnamed stream outside the site boundary which drains to the east into the Owenbeg River. The width of this feature varied from 0.3m up to 1m and had a bank depth of approximately 1.2m. The shape varied from u shaped to v shaped in places. During time of survey water level had a maximum level of approximately 10 cm. However, it is considered highly likely that the volume of water within features such as this throughout the site would increase during periods of higher precipitation especially during the winter months. Recolonising wetland plants at this area, included rushes (*Juncus spp*.), great willowherb, (*Epilobium hirsutum*), marsh thistle (*Cirsium palustre*) and ragged robin (*Lychnis flos-cuculi*). These drainage ditches have been constructed to drain these fields allowing for the improvement of pasture land for grazing. Drainage ditches also occurred along the margins of the conifer plantations which enhance the flow of water. The central section which is under first and second rotation forestry, is drained by a network of ditches (dry at time of surveying) that drain to a main drainage ditch flowing to the north, parallel to the hedgerow which bounds an overgrown forest track (firebreak), to east of T22. Some areas of these habitats lacked water and were overgrown with vegetation such as bramble (*Rubus fruticosus*) and purple moor-grass (*Molinia caerulea*) and are not included in this habitat.

13.2.4.10 Spoil and Bare Ground (ED2)

The forestry and farm roads within the proposed site fall into this habitat category and are dominated by compact gravel which is naturally occurring to the area. These roads came about by removing the top soil and the subsoil of sandstone and shale till formed the roads, which has a distinctive brown reddish colour. Other areas that fall into this habitat category include previous borrow pits and areas that have been cleared within other habitats such as entrances to fields where turn points exist and areas of disturbance where heavy trampling has occurred. These areas are readily invaded by plants. Some of the vegetation that does occur includes rough meadow-grass (*Poa trivialis*), germander speedwell (*Veronica chamaedrys*), common nettle (*Urtica dioica*) and dandelion (*Taraxacum officinale* agg.).

13.2.4.11 Buildings and artificial surfaces (BL3)

This category includes buildings, areas of land that are covered with artificial surfaces of tarmac, cement, paving stones, etc. (Fossitt, 2000). Within the Upperchurch Windfarm site, this category has been used to describe farm buildings, tracks, and a farm yard located to the southeast of the turbine T18. There are several roads and farm tracks throughout the site which would also fall into this category. Swallows, jackdaws and hooded crows were recorded in the vicinity of the farm buildings making them probable nesting sites.

13.2.4.12 Treelines WL2

A treeline is a narrow row or single line of trees that is greater than 5m in height. For the most part this habitat is limited to where the proposed site is bounded by tree-lined public roads. Two treelines occur in the north eastern section, between T10 and T11. Another section of treeline habitat recorded within the site occurs along the western boundary of the western section to the northwest of T19. Dominant species include sycamore (*Acer pseudoplatanus*), hawthorn (*Crataegus monogyna*) and oak (*Quercus robur*). There have been single rows of conifer planted along the hedgerows of agricultural grassland, to the southeast of turbine T1, but they are still juveniles and are not considered as part of this habitat.

13.2.4.13 Neutral grassland GS1

An area of land to the northwest of turbine T22, to the west of the conifer plantation is fenced off and is not managed as agricultural grassland. The sward was dominated by Yorkshire fog (*Holcus lanatus*) other grassland species included false-oat's grass (*Arrhenatherum elatius*), sweet vernal grass (*Anthoxanthum odoratum*) meadow foxtail (*Alopecurus pratensis*) and couch grass (*Agropyron repens*). Broadleaved herbs such as daisy (*Bellis perennis*), clovers (*Trifolium spp.*) and dandelion (*Taraxacum spp.*) were common.

TABLE 13-7: SPECIES OF FLORA RECORDED WITHIN THE STUDY AREA.

Common name	Latin name	Habitat
Alder	*Alnus glutinosa*	FW1 and WD4 (perimeter)
Annual meadow-grass	*Poa annua*	BL3, GA1, ED2and GS4
Ash	*Fraxinus excelsior*	WL2 (roadside)
Bell heather	*Ericea cinerea*	PB2, WL1, WD4 and HH3
Bilberry	*Vaccinium myrtillus*	PB2, HH3 and WL1
Black bog rush	*Schoenus nigricans*	PB2
Blackthorn	*Bursaria spinosa*	WL1
Bog myrtle	*Myrica gale*	PB2,WL1 and HH3
Bog-moss	*Sphagnum spp*	PB2, WL1 WD4 and HH3
Bramble	*Rubus fruticosus*	WL1 and WS1
Broad-leaved dock	*Rumex obtusifolius*	GA1, GS4 and WL1
Bulbous rush	*Juncus bulbosus*	PB2(pools) and FW4
Bush vetch	*Vicia sepium*	WL1 and roadside margins
Cleavers	*Galium asparine*	WL1 and roadside
Cocksfoot	*Dactylis glomerata*	GA1, ED2 and WL1
Common cotton-grass	*Eriophorum angustifolium*	PB2 and HH3
Common haircap	*Polytrichum commune*	PB2 and WD4
Common liverwort	*Marchantia polymorpha*	FW4
Common milkwort	*Polygala vulgaris*	HH3 and PB2 and stream bank
Common mouse-ear	*Cerastium fontanum ssp. vulgare*	GA1,GS4, WL1 and roadside
Common ragwort	*Senecio jacobaea*	GA1 and GS4
Common sedge	*Carex montana*	PB2 and HH3
Common spotted orchid	*Dactylorhiza fuchsii*	ED2,GS4 and PB2
Compact rush	*Juncus conglomerates*	GS4, GS3 and WD4
Cotton grass	*Eriophorum vaginatum*	PB2
Couch grass	*Agropyron repens*	GS1, GS1 and roadside
Cowslip	*Primula veris*	Roadside
Creeping bent	*Agrostis stolonifera*	GS4 and GA1
Creeping buttercup	*Ranunculus repens*	GA1, GS3 and GS4
Creeping thistle	*Cirsium arvense*	GA1 and GS4
Crested dog's-tail	*cynosures cristatus*	GA1, GS4 and GS3
Cross-leaved heath	*Erica tetralix*	PB2 and HH3 (Very little)
Cuckoo flower	*Cardamine pratensis*	GS4, GA1 and FW4
Cup lichen	*Clodonia spp.*	PB2 and HH3
Daisy	*Bellis perennis*	GA1, GS1, GS4, WL1, ED2 and GS3
Dandelions	*Taraxacum officinale agg.*	GA1.GS4, GS1 and ED2
Deergrass	*Trichophorum cespitosum*	PB2 and HH3
Downy Birch	*Betula pubescens*	Roadside
False oats-grass	*Arrhenatherum elatius*	GA1, GS1, WL1 and roadside verges
Fool's parsley	*Aethusa cynapium*	WL1 and roadside verges
Foxglove	*Digitalis purpurea*	WL1, GA1 by margins and road sides
Fuchsia	*Fuchsia magellancia*	WL1
Germander speedwell	*Veronica chamaedrys*	GA1, ED2 and WL1
Goat willow	*Salix caprea*	WL1, HH3, PB2 and FW1
Gorse	*Ulex europaeus*	WL1 and HH3(at margins)
Great willowherb	*Epilobium hirsutum*	GS4, BL3 and FW4

Common name	Latin name	Habitat
Greater plantain	*Plantago major*	GA1
Grey willow	*Salix cinerea*	WL1, and PB2
Hard fern	*Blechnum spicant*	HH3, WL1 and roadside
Hard rush	*Juncus inflexus*	GA1 and GS4
Harestail cotton-grass	*Eriophorum vaginatum*	PB3
Hart's-tongue fern	*Phyllitis scolopendrium*	WL1
Hawk's bit spp.	*Leontodon* spp.	WL1 and GA1 margin
Hawthorn	*Crataegus monogyna*	WL1
Hazel	*Corylus avellana*	WD1
Heath bedstraw	*Galium saxatile*	GS3
Heath milkwort	*Polygala serphyllifolia*	HH3 and PB2
Heath rush	*Juncus squarrosus*	HH3
Herb-robert	*Geranium robertianum*	WL1 and roadside (just outside site)
Himalayan balsam	*Impatiens glandulifera*	FW1 (Downstream of site)
Ivy	*Hedera helix*	WL2 and roadside
Japanese knotweed	*Fallopia japonica*	Roadside
Larch species	*Larix spp.*	WD4
Lesser spearwort	*Ranculus flammula*	GS4
Lesser stitchwort	*Stellaria graminea*	GA1, GS3 and WL1
Lichen (matchsticks)	*Cladonia florakena*	In disturbed peat area ED2
Liverwort sp.	*Marchantiophyta*	PB3
Lousewort	*Pedicularis sylvatica*	PB2 and HH3
Male fern	*Dryopteris Filix-Mas*	WL1 and WD4
Marsh bedstraw	*Gallium palustre*	HH3, GS4 and WL1
Marsh foxtail	*Alopercurus geniculatus*	GS4
Marsh lousewort	*Pedicularis palustris*	PB2
Marsh thistle	*Cirsium palustre*	GS4 and FW4
Marsh willowherb	*Epilobium palustre*	GS4
Meadow buttercup	*Ranunculus acris*	GA1, GS3 ,GS1, WL1 and GS4
Meadow foxtail	*Alopecurus pratensis*	GA1 and GS1
Meadow sweet	*Filipendula ulmaria*	GS4 , WL1 and roadside
Meadow thistle	*Cirsium dissectum*	GS4
Mountain ash	*Sorbus aucuparia*	WL1 and WL2
Mountain fern	*Oreopteris limbosperma*	FW1 (bank)
Nettle	*Utrica dioica*	GA1,ED2, WL1 and roadside
Oak	*Quercus robur*	WL2
Perennial rye-grass	*Lolium perenne*	GA1
Primrose	*Primula vulgaris*	WL1 and roadside
Purple loosestrife	*Lythrum salicaria*	GS4 and FW4
Purple moor-grass	*Molinia caerulea*	HH3, GS3 and PB2
Ragged robin	*Lychnis viscaria*	GA1, GS4 and FW4
Red bog-moss	*Sphagnum capillifolium*	PB2, WD4 and HH3 wet areas
Red clover	*Trifolium pratense*	GA1, GS4 and WL1
Red fescue	*Festuca rubra*	GA1, WL1, PB2 and HH3
Red-stemmed feather-moss	*Pleurozium schreberi*	PB3, WD4 and HH3
Ribwort plantain	*Plantago lanceolata*	GA1,GS1, ED2 and GS4
Rough meadow-grass	*Poa trivialis*	GA1, GS4 and ED2
Round-leaved crowfoot	*Ranunculus omiophyllus*	FW1 and FW4
Selfheal	*Prunella vulgaris*	ED2 and GA1

Common name	Latin name	Habitat
Sheep sorrel	*Rumex acetosella*	GA1, GS3 and GS4
Shepherds purse	*Capsella bursis-pastoris*	Roadside and ED2
Sitka spruce	*Picea sitchensis*	WL2 and WD4
Smooth meadow-grass	*Poa pratensis*	GA1
Soft rush	*Juncus effusus*	GA1, GS4, WD4, HH3, WL1 and PB2
Spear thistle	*Cirsium vulgare*	GA1
St. John's wort	*Hypericum sp.*	WL1 and ED2
Star sedge	*Carex echinata*	PB2, GS4, GS3 and HH3
Sweet vernal grass	*Anthoxanthum odoratum*	GA1, GS4, GS1, GS3, HH3, GS1, WD4 and HH3
Sycamore	*Acer pseudoplatanus*	WL2
Tormentil	*Potentilla erecta*	GA1, GS4, GS3, HH3, GS1, WD4 and PB2
Water mint	*Mentha aquatica*	GS4 and FW1
Watercress	*Rorippa nasturtium-aquaticum*	FW1
Water-starwort	*Callitriche sp.*	FW1
Wavy bittercress	*Cardamine flexuosa*	Roadside
White clover	*Trifolium repens*	GA1,GS4 and WL1
White willow	*Salix alba*	WL1
Wild angelica	*Angelica sylvestris*	GS4, GA1 and WL1
Yarrow	*Achillea millefolium*	GS3 and ED2
Yorkshire fog	*Holcus lanatus*	GA1, GS4, GS1 and WL1

13.2.5 Habitat Evaluation

Habitats have been evaluated below in Table 13-8 for their conservation importance based on the NRA evaluation scheme (see Table 13-2 above).

Those selected as key ecological receptors are those which are evaluated to be of at least local importance (higher value). The impacts of the proposed windfarm on these receptors are assessed below in section 13.3. The summary in Table 13-8 below illustrates the evaluation rating given to each habitat. The rationale behind these evaluations is also given.

TABLE 13-8: EVALUATION OF HABITATS WITHIN THE STUDY AREA.

Habitat (code)	Evaluation	Rating	Rationale	Ecological receptor
Improved Agricultural Grassland (GA1)	There is an extensive cover of Improved agricultural Grassland throughout the site. The habitat is species rich (as per agricultural grassland) and is of value to species which forage within it.	Locally important (higher value)	A species poor common habitat which has been given a higher rating due to the utilisation of the habitat by badger.	Yes
Wet Grassland (GS4)	This habitat is common in the lower lying areas and along margins of streams of the site. The wet grassland habitat has been modified by the building of drains around the field boundaries, reseeding and the application of fertiliser. While generally species poor the habitat is	Locally important (higher value)	Valuable habitat in itself but also forms transitions or mosaics with other habitats.	Yes

Habitat (code)	Evaluation	Rating	Rationale	Ecological receptor
	considered to be of some ecological value.			
Mosaic of Improved Grassland & Wet Grassland (GA1 / GS4)	Small sections found throughout the study area.	Locally important (higher value)	A species poor common habitat.	Yes
Mosaic Wet Heath & Upland Blanket Bog (HH3 / PB3)	Small sections scattered throughout the study area.	Locally important (higher value)	Good examples of this habitat mosaic in areas where disturbance has been limited.	Yes
Mosaic Upland Blanket Bog & Acidic Grassland (PB3 / GS3)	Mainly confined to one section of the study area.	Locally important (higher value)	Good examples of this habitat mosaic in areas where disturbance has been limited.	Yes
Wet Heath (HH3)	An area to the west of T2 in the south eastern section is classified as wet heath. This area was dominated by bell heather and purple moor-grass. This area would be subject to cattle grazing. Peat depth is low, approximately 0.3m. Formed due to peat extraction.	Local Importance (higher value)	Habitat has undergone disturbance by cattle grazing and reclamation. This is one example of good quality habitat within the study area.	Yes
Acid Grassland (GS3)	This habitat occurs mainly outside of the enclosed grassland farm areas in areas where no reclamation has taken place but is extensively grazed by cattle. This habitat occurs to the south east of turbines T3 and T4 and on steep slopes to the northwest of turbine T21. Scarce	Local Importance (higher value)	Habitat has undergone disturbance by Cattle grazing and reclamation. However there are good examples of the habitat within the study area.	Yes
Upland Blanket Bog (PB3)	Upland blanket bog is one of the least occurring habitats within the study area. The habitat has been degraded by previous peat extraction, land reclamation, conifer plantation, grazing and drainage.	County Importance	Good examples of this habitat in areas where disturbance has been limited.	Yes
Coniferous Plantation (WD4)	There are 7 stands of conifer plantation within the study area planted on heath/upland blanket bog habitat. The dense growth within this habitat means there is very little light penetration reducing the diversity of plant species at ground level. Some areas have been felled and replanted. The younger stands have much more diverse vegetation undergrowth.	Locally important (lower value)	Highly modified habitat.	No
Eroding/Upland River (FW1)	There are 3 small streams within the study area. These streams are quite small. Extensive man made drainage features drain into these habitats to dry out the surrounding low lying landscape.	Local Importance (higher value)	Low order streams whose water quality has been compromised land reclamation.	Yes

Habitat (code)	Evaluation	Rating	Rationale	Ecological receptor
Hedgerow (WL1)	There is a network of hedgerows along the improved grassland field boundary throughout the site.	Local Importance (higher value)	Some good examples of hedgerow habitat in conifer plantation margins and along road margins. Some within the study area have no tree or shrub coverage and are of lower ecological value.	Yes
Drainage Ditches (FW4)	Man-made features extending around the boundaries of lower lying agricultural fields and conifer plantation within the study area. Many are large with some vegetation.	Local Importance (higher value)	Some are not a good example of this habitat type but given a higher rating due to their potential following recolonisation.	Yes
Spoil and Bare Ground (ED2)	The forestry and farm roads within the site fall into this habitat category and are dominated by compact gravel which is naturally occurring to the area	Local Importance (lower value)	Modified habitat with potential with recolonisation to be of higher ecological value.	No
Buildings and Artificial Surfaces (BL3)	Habitat of very low ecological value.	Local Importance (lower value)	Highly modified habitat.	No
Treelines (WL2)	There are some small sections of treelines within the study area which mostly occur along tree-lined roads, This habitat occurs in the north eastern section between T 10 and T 11. Also a section of this habitat occurs along the western boundary of the western section.	Local Importance (higher value)	Some treelines particularly the broadleaved species offer potential roosting habitat for bats.	Yes
Neutral Grassland (GS1)	One small section of habitat within the study area.	Locally important (higher value)	Modified habitat.	Yes

The habitats listed in the tables above that are selected as key ecological receptors (based on an evaluation of at least local importance (higher value) are looked at in more detail below in terms of impact assessment (see section 13.3).

13.2.6 Flora

13.2.6.1 Rare and Protected Flora

The Study Area lies within Ordnance Survey National Grid 10km Squares R95 and R96. A plant species list for these 10km squares was generated from the CD-Rom version of the New Atlas of British and Irish Flora (Preston *et al.* 2002). Each 10km grid square was searched for records of plant species. This list was then compared to the lists of species protected under the Flora (Protection) Order of 1999 and the Irish Red Data Book (Curtis and McGough, 1988).

There were four plant species of conservation interest recorded within the 10 km grid squares R95 and R96. All four species are listed within the proposed new red data book list compiled by Naomi Kingston of the National Parks and Wildlife Service (2005). Table 13-9 presents details of the rare and protected plant species found within the 10km squares R95 and R96.

TABLE 13-9: RARE OR PROTECTED PLANT SPECIES RECORDED FROM 10KM SQUARE R95 INDICATED IN PRESTON *ET AL*. (2002).

Name	Most Recent Record Date (Preston *et al.*, 2002)	Notes
Bog Rosemary *Andromeda polifolia*	1987-1999	Irish Red Data Book (1988) IUCN = not threatened IRDB TN = 6 (Rare) Irish Red Data Book (2006) LC (Least Concern)
Cowslip *Primula veris*	1987-1999	Irish Red Data Book (1988) IUCN = not threatened IRDB TN = 8 (Rare) Irish Red Data Book (2006) LC (Least Concern)

Rare or Protected Plant Species recorded from 10km square R96 indicated in Preston *et al.* (2002).

Name	Most Recent Record Date (Preston *et al.*, 2002)	Notes
Greater Butterfly Orchid *Platanthera chlorantha*	1970-1986	Irish Red Data Book (2006) LC (Least Concern)
Small-white Orchid *Pseudorchis albida*	1970-1986	Irish Red Data Book (1988) IUCN = Endangered (Vulnerable) IRDB TN = 10 (Vulnerable) FPO 1999 Irish Red Data Book (2006) Endangered

13.2.6.2 Flora Protection Order species

Small White Orchid (*Pseudorchis albida*)

One species was recorded within the 10 km grid square R96 which is protected under the Flora Protection Order and is the species known as Small White Orchid (*Pseudorchis* *albida*), also known as the White Mountain Orchid, it is a rather rare species found in dry rough pasture in upland or coastal areas. It is a small plant, rarely over six inches, and bears small white flowers in a fairly tight spike from mid-June. The flowers have a sweet scent and carry nectar in the spurs which attract a wide variety of insects. The main centres of occurrence of this species are in the northern parts of Europe. Found in upland pastures and heaths in Ireland. The species was not recorded during surveying.

13.2.6.3Species of Conservation Interest

<u>Bog Rosemary (*Andromeda polifolia*)</u>

This is a very small undershrub which grows in some of our acid bogs, mostly in the centre of Ireland. It scarcely reaches 40 cm high, and can easily be missed as it grows surrounded by mosses. The species was not recorded during surveying.

<u>Cowslip (*Primula veris*)</u>

A perennial herb of well-drained, herb-rich grasslands on mesic to calcareous soils; is also found less commonly on seasonally flooded soils, in scrub or woodland rides and edges, and on calcareous cliffs (Preston *et al*. 2002). *P. veris* suffered a marked decline between 1930 and 1980 due to the ploughing or agricultural improvement of grassland. It has, however, recently become more frequent on road verges sown with this species or with wild-flower mixtures. Parnell *et al*. (2012) describes the species as being found in '*pastures; frequent in the centre, rather rare in the north-east and south-west*'. The species was not recorded during surveying.

<u>Greater Butterfly Orchid (*Platanthera chlorantha*)</u>

Greater butterfly-orchid is a perennial herb found in a wide variety of habitats, usually on well-drained calcareous soils. Typical habitats include downland, rough pasture, hay meadows, scrub, woodland and young plantations. It sometimes occurs on sand dunes and railway embankments. Rarely, it grows on slightly acidic soils in moorland and wet, heathy pasture (Preston *et al*. 2002). *P. chlorantha* was lost from many sites during the 20th century. Reasons include the felling, disturbance and coniferisation of woodland, and the agricultural improvement of pasture and scrub. It may be lost from woodland if the canopy becomes too dense (Preston *et al*. 2002 and Parnell *et al*. 2012). Records for the species date from 1970 – 1986. The greater butterfly-orchid was not recorded during surveys within the study area.

13.2.7 Mammals

Records for terrestrial mammals were retrieved from the NPWS and the National Biodiversity Data Centre online mapping. The publication "Exploring Irish Mammals" (Hayden and Harrington, 2000) was also used to access records of mammals within the Study Area. Species' distributions are shown by 20 kilometre squares, each of which consists of four OS 10km grid squares. The proposed windfarm is spread over two 20km squares, composed of 10km OS grid squares R95 and R96. A number of protected native mammal species are recorded for these 20km squares. Table 13-10 below lists these, and summarises their protected status and potential for occurrence within the Study Area. Bats are discussed in section 13.2.8.

TABLE 13-10: TERRESTRIAL MAMMAL SPECIES RECORDED WITHIN THE 10KM OS NATIONAL GRID SQUARES R95 AND R96.

Species	Identification of National Distribution	Source of Records	Level of Protection
Fallow Deer (*Dama dama*)	Scattered throughout Ireland.	R95 recorded on the 31/12/2008 (source *Irish Deer Database*) R96 recorded on the 25/10/2011 (source *Atlas of Mammals in Ireland 2010-2015*)	Wildlife (Amendment) Act (2000).
Irish Hare (*Lepus timidus hibernicus*)	Throughout Ireland	Hayden and Harrington (2000) R95 recorded on the 28/02/1990 (source *Badger and Habitats Survey of Ireland*) R96 recorded on 08/05/1990 (source *Badger and Habitats Survey of Ireland*)	Irish Red Data Book: 'Least Concern'. Wildlife (Amendment) Act (2000). Annex V Habitats Directive. Berne Convention Appendix III.
Otter (*Lutra lutra*)	Throughout Ireland	Hayden and Harrington (2000) R95 recorded on the 05/06/1980 (source *Otter survey of Ireland 1982*) R96 recorded on the 05/06/1980 (source *Otter survey of Ireland 1982*)	Irish Red Data Book 'Near Threatened'. Habitats Directive Annex II and IV. Berne Convention Appendix III. Wildlife (Amendment) Act (2000).
Pine Marten (*Martes martes*)	Throughout Ireland	R95 recorded on the 17/07/2009 (source *Atlas of Mammals in Ireland 2010-2015*) R96 recorded on the 14/11/2011 (source *Atlas of Mammals in Ireland 2010-2015*)	Irish Red Data Book: 'Least Concern'. Wildlife (Amendment) Act (2000). Habitats Directive Annex V
Badger (*Meles meles*)	Throughout Ireland	Hayden and Harrington (2000) R95recorded on the 19/05/2009 (source *Irish National Badger Set Datatbase*) R96 recorded on the 16/09/2008 (source *Irish National Badger Set Datatbase*)	Irish Red Data Book: 'Least Concern'. Wildlife (Amendment) Act (2000).
European Rabbit (*Oryctolagus cuniculus*)	Throughout Ireland	Hayden and Harrington (2000) R95 recorded on the 28/02/1990 (source *Badger and Habitats Survey of Ireland*) R96 recorded on the 08/05/1990 (source *Badger and Habitats Survey of Ireland*)	Irish Red Data Book: 'Least Concern'.
Red Fox (*Vulpes vulpes*)	Throughout Ireland	Hayden and Harrington (2000) R95 recorded on the 28/02/1990 (source *Badger and Habitats Survey of Ireland*) R96 recorded on the 08/05/1990	Mammal Red List for Ireland 2009: 'Least Concern'

Species	Identification of National Distribution	Source of Records	Level of Protection
		(source *Badger and Habitats Survey of Ireland*)	
Irish Stoat (*Mustela erminea subsp. Hibernica*)	Throughout Ireland	Hayden and Harrington (2000) R95 recorded on the 31/01/2012 Atlas of Mammals in Ireland 2010-2015	Wildlife (Amendment) Act (2000). Berne Convention Appendix III.
Hedgehog (*Erinaceus europaeus*)	Throughout Ireland	Hayden and Harrington (2000)	Irish Red Data Book: 'Least Concern'. Wildlife (Amendment) Act (2000). Berne Convention Appendix III.
Pygmy shrew (*Sorus minutes*)	Throughout Ireland	Hayden and Harrington (2000)	Irish Red Data Book: 'Least Concern'. Wildlife (Amendment) Act (2000). Berne Convention Appendix III.

There were no records of fallow deer (*Dama dama*), pine marten (*Martes martes*), hedgehog (*Erinaceus europaeus*) and Irish stoat (*Mustela erminea subsp. Hibernica*) during surveying. The habitats within the study area offer potential habitat for the species.

13.2.7.1 Badger

During the field survey badger activity was recorded in the south eastern section of the site. A trail was followed through a field which led to a gap in the hedgerow at the north eastern corner of the field where T7 is located. Fresh droppings were found at this site (GPS R96274 60423).

13.2.7.2 Otter

There were no signs of otter utilising habitats within the site during ecological surveys. However the stream south of turbines T9 and 10 and the section of stream downstream from the proposed development offer potential habitat for the species.

13.2.7.3 Irish (mountain) hare

Records presented on the National Biodiversity Ireland Website interactive map indicate that Irish hare have been recorded in grid square R95 and R96. There were no observations of Irish hare or associated field signs during the field survey within the study area. However the improved agricultural grassland fields, heath and upland blanket bog within the study area offer potential habitats for the species.

13.2.7.4 Red Fox

During the field survey there were several records of red fox (*Vulpes vulpes*) droppings within the study area. Fox trails were found skirting the edges of fields throughout the site, and a trail of fox prints was found on the north western edge of the western section of improved agricultural grassland (GPS R93006 61352). It is considered highly likely that fox are utilising the habitats within the site for foraging, shelter and potentially breeding.

13.2.7.5 Other mammals recorded

Field mice (*Apodemus sylvaticus*) and a pygmy shrew (*Sorus minutes*) were observed just outside the south eastern section of the site during a bat survey. There was no evidence of other mammal species of conservation interest within the study area.

13.2.8 Bats

Records for bat were retrieved from the NPWS and the National Biodiversity Data Centre online mapping. The proposed windfarm is spread over two 20km squares, composed of 10km OS grid squares R95 and R96. Table 13-11 below lists bat species recorded on the National Biodiversity Data centre online mapping, and summarises their protected status and potential for occurrence within the Study Area.

Table 13-11: Bat species recorded on National Biodiversity Data centre online mapping

Species	Source of Records	Level of Protection
Daubenton's Bat (*Myotis daubentonii*)	R95 recorded on the 08/08/2009 National Bat Database of Ireland	Protected Species: EU Habitats Directive. Annex IV Protected Species: Wildlife (Amendment) Act (2000).
Leisler's Bat (*Nyctalus leisleri*)	R95 recorded on the 08/08/2009 National Bat Database of Ireland	Protected Species: EU Habitats Directive. Annex IV Protected Species: Wildlife (Amendment) Act (2000).
Soprano Pipistrelle (Pipistrellus pygmaeus)	R95 recorded on the 08/08/2009 National Bat Database of Ireland R95 recorded on the 08/08/2009 National Bat Database of Ireland	Protected Species: EU Habitats Directive. Annex IV Protected Species: Wildlife (Amendment) Act (2000).
Brown Long-eared Bat (*Plecotus auritus*)	R96 recorded on the 08/08/2009 National Bat Database of Ireland	Protected Species: EU Habitats Directive. Annex IV Protected Species: Wildlife (Amendment) Act (2000).
Pipistrelle (*Pipistrellus pipistrellus sensu lato*)	R96 recorded on the 08/08/2009 National Bat Database of Ireland	Protected Species: EU Habitats Directive. Annex IV Protected Species: Wildlife (Amendment) Act (2000).

13.2.8.1 Ecology

Bats in Ireland feed exclusively on insects and in the summer they generally emerge from their roosts at dusk to feed. The distances covered while foraging varies considerably between species. They are known to use a number of different foraging sites in the same night and move between them to locate areas of high insect density. They are also known to exhibit a level of site loyalty and will frequently return to the same foraging sites night after night (Joint Nature Conservancy Committee JNCC, 2001).

13.2.8.2 Results of bat survey

Driven bat transect surveys were carried out on the 21st of June 2012 around the perimeter of all sections of the proposed site to get a snapshot of bat species that use the area. During previous on-site ecological daytime surveys, possible roost sites, such as buildings and structures were highlighted. When designing potential surveying locations around each section of the proposed site and the surrounding habitats, features of particular interest to bat species were identified, namely linear habitats, such as buildings, water features (rivers and streams), hedgerows and treelines. Features such as these, could be used by bats to commute and hunt. No signs of activity were recorded during daytime surveys. However one old building/farm buildings and farmyard was flagged as offering potential bat roosting sites. The old farm house and buildings are located outside the site. Table 13-12 below summarises the details of the bat transect surveys conducted. The results of the bats surveys carried out around the perimeter of each section and the surrounding habitats are shown in Table 13-12.

TABLE 13-12: DETAILS AND RESULTS OF THE BAT SURVEY CARRIED OUT AT UPPERCHURCH

Survey Location	Start time	Finish time	Details of results
Bat Transect 1	00:55	01:06	2 Brown long eared bat calls. 2 recorded at end of transect along hedgerow and broadleaf treeline
Bat Transect 2	01:09	01:29	31 common pipistrelle calls recorded for the most part of the transect. Commuting and hunting along hedgerow and roadside treeline
			1 Brown long eared bat recorded towards end of transect feeding along forest edge habitat
Bat Transect 3	01:35	01:51	10 common pipistrelle calls recorded. Commuting and hunting along hedgerows
Bat Transect 4	01:52	02:02	5 common pipistrelle calls recorded along hedgerow with some broadleaf tree cover
Bat Transect 5	02:04	02:13	36 confirmed common pipistrelle calls. Observed commuting along forest edge and hedgerows. This species was recorded for the most part of the transect.
			2 Soprano pipistrelle calls commuting and hunting
			1 whiskered/Brandts bat
Bat Transect 6	02:18	02:39	1 common pipistrelle call in commuting/hunting along broadleaf treeline
			2 brown long eared bat calls one recorded commuting/hunting along hedgerow. One recorded at the end of the western leg of this transect just east of conifer treeline and farmyard
Bat Transect 7	02:40	03:00	1 whiskered/Brandts bat recorded at beginning of transect where forest edge and hedgerow merged.
			6 common pipistrelle calls recorded along hedgerow habitat with dwelling houses close by
Bat Transect 8	02:52	03:05	5 common pipistrelle calls recorded along hedgerow and broadleaf treeline

13.2.8.3 Discussion of results

Four species of bat were recorded in all during the survey namely common pipistrelle (*Pipistrellus pipistrellus*), Soprano pipistrelle (*Pipistrellus pygmaeus*), brown long eared bat (*Plecotus auritus*) and either a whiskered (*Myotis mystacinus*) or Brandt's bat (*Myotis brandtii*). The *Myotis* species, the whiskered/Brandt's bat was recorded during Bat Transect (BT) 5 along a hedgerow and a mix of broadleaf and conifer treeline located to the north-east of the western section. Two calls were heard during the entire transects routes, with the second pass recorded at the beginning of BT 7, just to the south of the western section. The calls were not identified to species during the survey due to the difficulty in distinguishing the difference in whiskered and Brandt's bat. Although the whiskered bat is widely distributed throughout Ireland, there are relatively few records (NPWS, 2009). O'Sullivan (1994) recorded that whiskered bats are found in houses during the summer, roosting in small numbers in the roof space, often between the rafters and felt or in narrow slits where timbers meet, where they are difficult to observe. Surveys in east cork conducted by Pat Smiddy

(1991) found a male and female whiskered bat roosting in a bridge, a behaviour also recorded at a bridge in co. Leitrim (Shiel, 1999).

As already stated Brandt's bat is very similar and closely related to the whiskered bat so it is possible that the two have been confused in the past. This species is very rare and has only been confirmed from one location in Ireland to-date (Co. Wicklow, 2003). On the continent it is considered a forest bat and is less associated with human settlements than the whiskered bat. It often hunts over water and in forest. Its roosting and foraging preferences in Ireland are unknown (BCI, 2012).

Overall 6 passes of brown long eared bat were recorded, along transects BT 1, BT 2 and BT 6, commuting and hunting along the foliage of hedgerows and forest edge. Brown long□eared bats rely heavily on artificial roosts (Swift, 1998). The natural summer roosts of this species are generally tree holes. However, artificial roosts such as attic spaces have replaced many natural structures and in some ways may even be more beneficial than natural tree holes. Attics can provide the more stable thermal conditions necessary for maternity roosts while allowing young bats to practice flying safely before leaving the roost. This species is described as a 'fissure rooster' maintaining constant contact with roof beams on both sides. As a result, brown long□eared bats are more frequently found roosting in the apex of the roof, in the angle between the ridge beam and the rafters or at the gable ends between stone walls and wooden beams (Swift, 1998). The brown long□eared bat is often known as the 'whispering bat' because its sensitive hearing enables it to locate prey by passive listening (Anderson & Racey, 1993). As a consequence, its echolocation calls are of low intensity (Russ, 1999). Brown long□eared bats typically produce short duration (2ms) frequency modulated (FM) echolocation calls sweeping from about 80 to 20 kHz with a prominent second harmonic (Ahlén, 1981). The low intensity calls of the brown long□eared bat means that the detection of such calls by bat detectors is limited to a distance of approximately 0.7m and the main axis of sound emitted by the bat is directed within approximately 120° of the front of the receiving microphone of the bat detector (Anderson & Racey, 1993). Therefore, relying on bat detectors to monitor hunting brown long□eared bats is problematic and, as a result, a foot or car□based transect bat monitoring survey for this species will not yield sufficient data to allow full monitoring of species.

Common pipistrelle, were the most recorded species with 73 passes throughout the whole survey. This is one Ireland's most common species and was recorded along all transects, except for transect BT 1. The relatively recent discovery that the species formerly known as the pipistrelle (*Pipistrellus pipistrellus*) was in fact two separate but cryptic species, the common pipistrelle and the Soprano pipistrelle, has been well documented (Barratt *et al.*, 1997). O'Sullivan (1994) found 584 pipistrelle bat roosts during the National Bat Survey, the highest number for any species, and described it as the most abundant in Ireland and widely distributed. It is worth noting however that both species were considered to be the same at that time. It has been established following their separation that the common and Soprano pipistrelles were the most common and second most common species encountered respectively (Roche *et al.*, 2007). Two passes of Soprano pipistrelle was recorded along transect BT 5. Both species were observed hunting midges and moths along hedgerows and treelines, flying rapidly and twisting in flight. A single pipistrelle (weighing approximately 5-

6g) may consume as many as 3,500 of these insects in one night (BCI, 2012). Summer roosts of Soprano and common pipistrelles are normally in buildings (NPWS, 2009). Pipistrelles are frequently found roosting in houses, although they also roost in other locations such as tree holes. In houses they prefer to occupy confined spaces such as behind hanging tiles and soffit boards or between roofing felt and roof tiles, rather than the main attic space (BCI, 2012, McGuire, 1998 and Allen *et al*., 2000).

The majority of the activity was recorded along BT 5, recording all species that were encountered during the whole survey. This route runs parallel with the western section of the site and is adjacent to most habitats that occur within the site. The weather conditions at the time of the survey were favourable for bats. Following the survey it can be concluded that the habitats at the Upperchurch site support a healthy population of common pipistrelle and to a lesser extent brown long eared bat, Soprano pipistrelle and whiskered/Brandts bat. Table 13-13 below shows the species recorded during the bat survey at the Upperchurch site.

TABLE 13-13 BAT SPECIES RECORDED DURING SURVEY

Common name	Scientific name
Common pipistrelle	*(Pipistrellus pipistrellus)*
Soprano pipistrelle	*(Pipistrellus pygmaeus)*
Brown long eared bat	*(Plecotus auritus)*
Whiskered/Brandts bat	*(Myotis sp.)*

Table 13-14 summarises the description of the transects carried out at the Upperchurch windfarm site. See **Figure 13-6** at the end of this report for locations of the bat transect routes.

TABLE 13-14: DESCRIPTION OF TRANSECTS

Transect code	GPS start	GPS finish	Description of each transect and associated habitat
BT 1	96896 59485	95392 59954	Driven transect. Approximately 2.94km in length. Split the south eastern section of the site. Habitats included hedgerows, approximately 350m of treeline of mostly broadleaf, second rotation conifer plantation, improved grassland and 6 houses
BT 2	95748 61133	97218 62928	Driven transect. Approximately 4km in length that for most part ran parallel to north eastern section. Habitats included; hedgerows, approximately 500m of mostly broadleaf treeline and agricultural grassland. The second leg of transect ran along the northern boundary through 1.25km of conifer plantation
BT 3	96257 63623	97090 61704	Driven transect. Approximately 4.33km in length that looped from northwest to eastern boundary of the location of turbines T9 to T16. Finished at old farm yard. Habitats included; hedgerows, approx. 270m of treeline, second rotation conifer plantation and improved grassland
BT 4	96493 60911	94345 60759	Driven transect. Approx. 3.30km in length. Bisected north eastern (turbines T9-T16) and south eastern (turbines T1-T8) sections. Split central section towards end of transect. Habitats include buildings/farm buildings, improved agricultural grassland, single broadleaf trees and stream.
BT 5	94034	94824	Driven transect. Approx. 2.50km. Ran along the east/northeast

Transect code	GPS start	GPS finish	Description of each transect and associated habitat
	60664	62635	of the western section. Habitats included approx. 750 of conifer plantation, hedgerows and improved agricultural grassland.
BT 6	94824 62635	94117 61866	Driven transect. Approx. 2.80km. Looped from the northeast to the west of the western section. The second leg of this transect ran through the northern part of this section. Habitats included agricultural grassland, peatland and hedgerows
BT 7	92585 59719	94034 60664	Driven transect. Approx. 1.96km. Parallel along the southern boundary of the western section. Habitats included; improved agricultural grassland, hedgerows, dwelling houses, and approx. 30m of conifer plantation towards the end of the transect
BT 8	94217 58634	96896 59485	Driven transect. Approx.3.42km. Looped around south eastern section, from the south to linking up with the starting point of BT 1. Habitats included; improved grassland, hedgerows, dwelling houses, and approx. 50m stretch of a broadleaf treeline.

13.2.9 Aquatic Ecology

A water quality assessment was undertaken of the waterways draining the study area of the proposed wind farm to provide baseline water quality, fisheries and riparian habitat data. Watercourses in the vicinity of the proposed development were surveyed by an ecologist on the 11th of June and the 22nd of August 2012.The survey results will provide a baseline for future monitoring to ensure that the existing water and habitat quality of watercourses within and adjacent to the site are maintained during the construction and operational phase of the proposed wind farm development.

The study area is situated on hills or drumlins with a number of streams that support the upper reaches of the Owenbeg, Clodiagh and Turraheen River catchments which drain to the Suir. Tributaries of the Clodiagh River drain the northern and central locations of the site while the southern and eastern portion of the site are drained by tributaries of the Owenbeg and Turraheen Rivers. The Aughvana River drains the site to the west and southwest, which is part of the Shannon River Basin District and joins the Mulkear River to the south west.

A total of six sampling points were strategically identified at locations within the catchment area of the proposed Upperchurch Windfarm site in order to assess and give an indication on the water quality in the immediate area surrounding the proposed site. Table 13-15 details the grid references of each Q value sampling station on which the survey was undertaken. The locations of these sampling stations are shown in **Figure 13-5** at the end of this chapter.

Table 13-15: Location of Sampling Stations for the water quality survey.

Sampling Station	Grid Reference	Location
1	97973 61082	Unnamed stream (east of site) which flows to the Owenbeg River
2	97336 59293	Owenbeg river (east of site)
3	94363 59329	Unnamed stream (southern section of the site) which flows to the Turraheen River
4	95056 62330	Unnamed stream (central area of site) which flows to the Clodiagh River
5	94623 63001	Unnamed stream (northern section of the site) which flows to the Clodiagh River
6	93464 59759	Unnamed stream (southern section of the site) which flows to the Aughvana River

13.2.9.1 Results of Q sampling survey

Table 13-16 outlined the characteristics of the sampling stations.

TABLE 13-16: CHARACTERISTICS OF THE SAMPLING STATIONS

Station number 1					
Date	11th June 2012	**DO%**	103.4	**Conductivity (µS)**	173
GPS Location	97973 61082	**DO mg/L**	11.31	**pH**	7.5
GPS Accuracy	4m	**Temp (°C)**	11.28	**TDS (g/L)**	0.043

Bank Width	1.8m
Wet Width	1.5m
River Depth:	16.5cm
Velocity:	V. slow
Clarity :	Slightly turbid
Colour:	Slight
Dominant substrate:	Gravel & Mud
Filamentous Green Algae:	None
Macrophytes :	Normal growth
Sewage Fungus:	None
Siltation:	Heavy
Surrounding land type:	Pasture
Outflow pipes:	None
Shading:	Medium
Cattle Access:	Yes
Stream flow type:	Slow flow

Sampled in minutes	*Stone wash*	1 minute	*Kick sampling*	2 minutes
Further comments	Depth of mud in areas up to 10cm During time of sampling field to east closed for silage. Field to west wet grassland/no fencing Evidence of cattle encroachment Geology- Silurian meta-sediments & volcanic with shallow peat top soil			

<table>
<tr><th colspan="6">Station number 2</th></tr>
<tr><td>Date</td><td>11th June 2012</td><td>DO%</td><td>108.0</td><td>Conductivity (μS)</td><td>157</td></tr>
<tr><td>GPS Location</td><td>97336 59239</td><td>DO mg/L</td><td>11.64</td><td>pH</td><td>7.6</td></tr>
<tr><td>GPS Accuracy</td><td>4m</td><td>Temp (°C)</td><td>11.98</td><td>TDS (g/L)</td><td>0.33</td></tr>
<tr><td>Bank Width</td><td>1.9m- 2.0m</td><td colspan="4" rowspan="15"></td></tr>
<tr><td>Wet Width</td><td>1.80m</td></tr>
<tr><td>River Depth:</td><td>Avg - 16.5cm
Max - 30cm</td></tr>
<tr><td>Velocity:</td><td>Fast</td></tr>
<tr><td>Clarity :</td><td>Clear</td></tr>
<tr><td>Colour:</td><td>Peat Stained/slight</td></tr>
<tr><td>Dominant substrate:</td><td>(Cobbles 65%)
(Boulder 15%)
sand/gravel</td></tr>
<tr><td>Filamentous Green Algae:</td><td>None</td></tr>
<tr><td>Macrophytes :</td><td>Normal growth</td></tr>
<tr><td>Sewage Fungus:</td><td>None</td></tr>
<tr><td>Surrounding land type:</td><td>To south riparian woodland/ to north improved grassland</td></tr>
<tr><td>Outflow pipes:</td><td>None</td></tr>
<tr><td>Shading:</td><td>Moderate</td></tr>
<tr><td>Cattle Access:</td><td>None</td></tr>
<tr><td>Stream flow type:</td><td>Riffle and glide</td></tr>
<tr><td>Sampled in minutes</td><td>Stone wash</td><td>1 minute</td><td>Kick sampling</td><td colspan="2">2 minutes</td></tr>
<tr><td>Further comments</td><td colspan="5">Slightly peat stained water
Field to north cattle grazing
Species note: Brown trout, freshwater limpet. To immediate south WN5 with alder and willow</td></tr>
</table>

<table>
<tr><th colspan="6">Station number 3</th></tr>
<tr><td>Date</td><td>11th June 2012</td><td>DO%</td><td>102.8</td><td>Conductivity (µS)</td><td>261</td></tr>
<tr><td>GPS Location</td><td>94363 59329</td><td>DO mg/L</td><td>11.58</td><td>pH</td><td>7.2</td></tr>
<tr><td>GPS Accuracy</td><td>4m</td><td>Temp (°C)</td><td>10.03</td><td>TDS (g/L)</td><td>0.49</td></tr>
<tr><td>Bank Width</td><td>1.9m- 2.0m</td><td colspan="4" rowspan="15"></td></tr>
<tr><td>Wet Width</td><td>1m</td></tr>
<tr><td>River Depth:</td><td>Avg - 12.5cm
Max - 20cm</td></tr>
<tr><td>Velocity:</td><td>Fast</td></tr>
<tr><td>Clarity :</td><td>Clear</td></tr>
<tr><td>Colour:</td><td>Peat Stained/slight</td></tr>
<tr><td>Dominant substrate:</td><td>(Cobbles 40%)
(Boulder 15%)
sand/gravel</td></tr>
<tr><td>Filamentous Green Algae:</td><td>Trace</td></tr>
<tr><td>Macrophytes :</td><td>Normal growth</td></tr>
<tr><td>Sewage Fungus:</td><td>None</td></tr>
<tr><td>Surrounding land type:</td><td>To northwest improved wet grassland. Steep bank to south west then conifer plantation</td></tr>
<tr><td>Outflow pipes:</td><td>None</td></tr>
<tr><td>Shading:</td><td>Medium</td></tr>
<tr><td>Cattle Access:</td><td>Yes</td></tr>
<tr><td>Stream flow type:</td><td>Riffle and glide</td></tr>
<tr><td>Sampled in minutes</td><td>Stone wash</td><td>1 minute</td><td>Kick sampling</td><td colspan="2">2 minutes</td></tr>
<tr><td>Further comments</td><td colspan="5">Slightly peat stained water
Field to northwest cattle grazing. To south east steep bank (5m) with narrow stretch of conifer plantation (Sitka spruce) 4 trees deep
Species note: Water starwort in pool areas (light cover)</td></tr>
</table>

Station number 4					
Date	11th June 2012	**DO%**	104.3	**Conductivity (µS)**	188
GPS Location	95056 62330	**DO mg/L**	11.15	**pH**	7.77
GPS Accuracy	4m	**Temp (°C)**	12.29	**TDS (g/L)**	0.29

Bank Width	2.0 - 2.30m
Wet Width	2.10m avg
River Depth:	Avg - 16.5cm Max - 30cm
Velocity:	Fast
Clarity :	Clear
Colour:	Peat Stained/slight
Dominant substrate:	(Cobbles 60%) (Boulder 10%) sand/gravel
Filamentous Green Algae:	Trace
Macrophytes:	Normal growth
Sewage Fungus:	None
Surrounding land type:	Pasture
Outflow pipes:	None
Shading:	medium
Cattle Access:	None
Stream flow type:	Riffle and glide

Sampled in minutes	*Stone wash*	1 minute	*Kick sampling*	2 minutes
Further comments	Fields to west saved for silage harvesting. Field to east recent cattle grazing wet grassland with areas of scrub. Geology- Silurian metasediments & volcanic. Soils mineral alluvium. Immediate bank areas very wet.			

Station number 5					
Date	11th June 2012	**DO%**	105.0	**Conductivity (µS)**	146
GPS Location	94623 63001	**DO mg/L**	11.20	**pH**	7.6
GPS Accuracy	4m	**Temp (°C)**	12.45	**TDS (g/L)**	0.26

Bank Width	4 - 4.5m
Wet Width	4.1m
River Depth:	Avg - 14.5cm Max - 25cm
Velocity:	Fast
Clarity :	Clear
Colour:	Peat Stained/slight
Dominant substrate:	(Cobbles 55%) (Boulder 20%) sand/gravel
Filamentous Green Algae:	Trace
Macrophytes :	Normal growth
Sewage Fungus:	None
Surrounding land type:	Pasture to west/woodland N/NE
Outflow pipes:	None
Shading:	Medium
Cattle Access:	Yes
Stream flow type:	Riffle and glide

Sampled in minutes	*Stone wash*	1 minute	*Kick sampling*	2 minutes
Further comments	Slightly Peat stained Water. Animals were observed crossing river downstream of survey site. Species note: Very species diverse			

Station number 6					
Date	22nd August 2012	**DO%**	101.1	**Conductivity (µS)**	169
GPS Location	93464 59759	**DO mg/L**	11.35	**pH**	7.6
GPS Accuracy	2m	**Temp (°C)**	12.10	**TDS (g/L)**	0.041

Bank Width	2.2m
Wet Width	1.3m
River Depth:	Avg 12cm Max 20cm
Velocity:	Fast
Clarity :	Slightly turbid
Colour:	Slight
Dominant substrate:	Cobble50% Gravel 20% Boulder5% & fine gravel
Filamentous Green Algae:	Trace
Macrophytes :	Normal growth
Sewage Fungus:	None
Siltation:	Slight
Surrounding land type:	Pasture
Outflow pipes:	None
Shading:	Medium
Cattle Access:	Yes
Stream flow type:	Riffle/Glide

Sampled in minutes	*Stone wash*	1 minute	*Kick sampling*	2 minutes
Further comments	During time of sampling field to east had recent cattle grazing. Field to west improved grassland/steep bank. No fencing on either bank. Evidence of cattle encroachment. Shading during time of survey was 25%. Further downstream on the west of R497 the stream in used as roadway. Geology- Silurian metasediments & volcanic with shallow peat top soil.			

13.2.9.2 Results of Q sampling survey

Table 13-17 below lists the results of the Q sampling survey.

TABLE 13-17: RESULTS OF Q SAMPLING SURVEY

Sampling Station	Common Name	Latin Name	Frequency	Count	Group	Q-Value Indicated
1	Stonefly larvae	Leuctra spp.	Small numbers	6	B	Q3
	Caddis fly larvae	*Trichoptera spp.*	Fair numbers	13	B	
	Mayfly larvae	*Baetidae spp.*	Common	18	B	
	Cased caddis fly larvae	*Trichoptera spp.*	Small numbers	7	C	
	Snail	*Planorbidae spp.*	Scarce	3	C	
	Shrimp	*Gammarus duebeni*	Common	15	C	
	Midge larvae	*Chironomidae spp.*	Common	12	C	
	Cranefly	*Tipulidae spp.*	Scarce	3	C	
	Water beetle	*Coleoptera spp.*	Fair numbers	10	C	
	Leech	*Hirudinea spp.*	Fair numbers	8	D	
	Midge larvae	*Chironomus spp.*	Scarce	3	D	
	Brown trout	*Salmo trutta fario.*	Present	2	n/a	
2	Caddisfly	*Trichoptera spp.* (Uncased)	Common	58	*C*	Q4
	Crustacean	*Gammarus duebeni*	Numerous	180	*C*	
	Limpet	*Gastropoda spp.*	Scarce	6	*N/a*	
	Blackfly	*Simuliidae spp.*	Fair numbers	45	*C*	
	Mayfly	*Heptageniidae spp.*	Fair numbers	30	*A*	
	Mayfly	*Siphlonuridae spp.*	Small numbers	8	*A*	
	Caddisfly	*Trichoptera spp. (Cased)*	Common	67	*B*	
	Stonefly	*Leuctra spp.*	Scarce	3	*B*	
	Mayfly	*Baetidae spp.*	Common	49	*B*	
	Midge larvae	*Chironomidae spp.*	Small numbers	18	C	
	Mayfly	*Ephemerellidae spp.*	Scarce	5	C	
	Brown Trout	*Salmo trutta fario*	Present	1	*N/a*	
3	Mayfly	*Heptageniidae spp.*	Common	88	A	Q4
	Caddisfly	*Trichoptera spp.* (Cased)	Common	70	B	
	Stonefly	*Leuctra spp.*	Small	20	B	

Sampling Station	Common Name	Latin Name	Frequency	Count	Group	Q-Value Indicated
			numbers			
	Mayfly	*Baetidae spp.*	Dominant	560	*B*	
	Shrimp	*(Gammarus duebeni)*	Fair numbers	60	C	
	Caddisfly	*Trichoptera spp.* Uncased spp	Small numbers	20	C	
	Blackfly	*Simuliidae spp.*	Small numbers	15	C	
	Midge larvae	*Chironomidae spp.*	scarce	5	C	
	Cranefly	*Tipulidae spp.*	Present	1	C	
	Snail	*Planorbidae spp.*	Present	2	C	
	Leaf beetle	Chrysomelidae spp.	Present	1	C	
4	Mayfly	*Heptageniidae spp.*	Numerous	150	A	Q4
	Mayfly	*Siphlonuridae spp.*	Small numbers	10	A	
	Stonefly	*Nemouridae spp.*	Small numbers	10	A	
	Caddisfly	*Trichoptera spp.* (Cased)	Fair numbers	35	B	
	Stonefly	*Leuctra spp.*	Small numbers	5	B	
	Mayfly	*Baetidae spp.*	Common	50	B	
	Shrimp	*Gammarus duebeni*	Fair numbers	20	C	
	Caddisfly	*Trichoptera spp. (Uncased)*	Small numbers	10	C	
	Cranefly	*Tipulidae spp.*	Small numbers	5	C	
	Blackfly	*Simuliidae spp.*	Numerous	125	C	
	Water beetle	*Coleoptera spp.*	Scarce	2	C	
5	Mayfly	*Heptageniidae spp.*	Numerous	120	A	Q4-5
	Stonefly	*Perla bipuncata*	Scarce	4	A	
	Stonefly	*Nemouridae sp*	Scarce	5	A	
	Caddisfly	*Trichoptera spp.* (Cased)	Common	65	B	
	Mayfly	*Baetidae spp.*	Scarce	5	B	
	Stonefly	*Leuctra spp.*	Scarce	5	B	
	Shrimp	*Gammarus duebeni*	Scarce	5	C	
	Uncased caddisfly larvae	*Trichoptera*	Small numbers	10	C	
	Cranefly larvae	*Tipulidae spp.*	Small numbers	13	C	
	Blackfly larvae	*Simuliidae spp.*	Small numbers	10	C	
	Water beetle larvae	*Coleoptera spp.*	Scarce	5	C	
	Mayfly larvae	*Ephemerellidae*	Common	27	C	

Sampling Station	Common Name	Latin Name	Frequency	Count	Group	Q-Value Indicated
		spp.				
	Mayfly larvae	*Caenidae spp.*	Small numbers	7	C	
	Limpet	*Gastropoda spp.*	Scarce	4	N/a	
6	Stonefly larvae	*Leuctra spp.*	Present	2	B	Q3
	Caddis fly larvae	*Trichoptera spp.(cased)*	Small numbers	35	B	
	Mayfly larvae	*Baetis rhodani*	Common	75	C	
	Cased caddis fly larvae	*Trichoptera spp.*	Scarce/Few	5	C	
	Mud snail	*Hydrobiidae spp.*	Present	2	C	
	Shrimp	*Gammarus duebeni*	Dominant	300	C	
	Midge larvae	*Chironomidae spp.*	Small numbers	10	C	
	Black fly	*Simuliidae spp.*	Dominant	360	C	
	Limpet	*Gastropoda spp.*	Present	1	N/A	

Sampling station 1: Q value

The water quality at sampling station 1 was Q3. This sampling site is a first order stream which eventually forms part of the Owenbeg River. Group A sensitive macroinvertes were absent, groups B less sensitive forms were numerous represented by two species of stonefly (*Leuctra spp.*), cased caddisfly larvae (*Trichoptera spp.*), and mayfly (*Baetidae spp.*). Group C relatively tolerant species were also numerous with the sample including the water shrimp (*Gammarus duebeni*), and midge larvae (*Chironomidae spp.*). Group D tolerant species of macroinvertebrates were present in small numbers represented by a species of leech (*Hirudinea spp.*). Group E, the most tolerant species of macroinvertebrates were scarce with only a few midge larvae (*chironomus spp.*) collected. When a silt plume test was carried out heavy siltation was observed, which also indicates Q3. This kick sampling station is located on agricultural land that is used for cattle grazing with the field to the east of the sampling station being closed for silage during time of sampling and the field to the west of the sampling station having just being recently grazed with cattle dung observed throughout the site. The stream is fenced off from farm animals to the east at this sampling station with a line of thorny wire. Animals would have access to the stream from the west of the sampling point as fencing was absent. There were areas along the west side of the stream (at the sampling station) where recent encroachment by cattle to the stream was observed. This would influence the water quality in the immediate area and downstream because of siltation and the introduction of cattle excrements.

Sampling station 2: Q value

The water quality at sampling station 2, a tributary of the Owenbeg river (east of site), was Q4. Eleven taxa were recorded within the kick sample with species from group C, relatively tolerant species dominating, these included the water shrimp (*Gammarus duebeni*), uncased caddisflys (*Trichoptera spp.*), blackfly (*Simuliidae spp.*), midge larvae (*Chironomidae sp*) and mayflies (*Ephemerellidae spp.*). Group A the most sensitive species were common with mayflies (*Heptageniidae spp.*) and (*Siphlonuriidae spp.*) recorded in the sample. The presence of these taxa in waterbodys would indicate a relatively pristine habitat. Group B less sensitive species were numerous in the sample and included cased caddisfly species (*Trichoptera spp.*), stonefly (*Leuctra spp.*) and a species of mayfly (*Baetidae spp.*). Groups D and E tolerant species were not recorded in the sample. There was a slight growth of filamentous algae on boulders and cobbles within the stream. The silt plume test recorded slight siltation and no sewage fungus was seen to be present within the sampling area. Macrophytes were mostly confined to near bank areas as stream flow would be normally fast in this area of the stream. Macrophytes included species of moss (*Sphagnum spp.*). Dissolved oxygen saturation levels of 108% were recorded.

Sampling station 3: Q value

The water quality at sampling station 3 was Q4. This stream forms part of the Turraheen River. Eleven taxa were recorded within the kick sample. Of the group A taxa, two species of mayfly (*Heptageniidae spp.*) were common within the sample. Group B less sensitive species were dominant in the sample which included species of cased caddisfly (*Trichoptera spp.*), stonefly (Leuctra spp.) and a species of mayfly (*Baetidae spp.*) which was the overall dominant species within the sample. Group C relatively tolerant taxa had fair numbers with the water shrimp (*Gammarus duebeni*), uncased caddisfly (*Trichoptera spp.*) and species of blackfly (*Simuliidae spp.*) having small numbers. Non biting midge larvae (*Chironomidae spp.*) were scarce and the rams horn snail (*planorbidae spp.*) and a leaf beetle (*chrysomelidae spp.*) were present with one or two individuals. Groups D and E the most tolerant species were absent. No sewage fungus was recorded along the sampling area. Macrophytes were mostly confined to near bank areas as stream flow would normally be fast in this area. Macrophytes included brooklime (*Veronica beccabunga*), moss species (*Sphagnum spp.*) and a slight growth of filamentous algae on stones and boulders. A silt plume test recorded slight siltation and dissolved oxygen saturation showed levels of 102.8% DO.

Sampling station 4: Q value

The water quality at sampling station 4 was Q4. Eleven taxa were recorded within the kick sample. Group A sensitive species were dominant which included three species of mayfly (*Heptageniidae spp.*), (*Siphlonuridae spp.*) and a species of stonefly (*Nemouridae spp.*). Group B less sensitive species were common with cased caddisfly (*Trichoptera spp.*) and mayfly (*Baetidae* spp.) having fair numbers and small numbers of stonefly (*Leuctra spp.*). Group C relatively tolerant species were numerous with blackfly species (*Simuliidae spp.*) being the most dominant taxa within this group. The water shrimp (*Gammarus duebeni*), uncased caddisfly (*Trichoptera spp.*) had small numbers. Cranefly (*Simuliidae spp.*) and the water beetle (*Coleoptera spp.*) were present within the kick sample. The silt plume test recorded moderate siltation which could be because of quite an amount of erosion which was observed 300 meters upstream. Macrophytes included moss species (*Sphagnum spp.*) and a slight growth of filamentous algae on cobbles and boulders. Emergent macrophytes were limited to Yorkshire fog (*Holcus lanatus*) in this sampling area, confined to near bank areas as stream flow would be normally fast in this area of the stream. Sewage fungus was not observed at the sampling location and dissolved oxygen saturation had levels of 104.3%.

Sampling station 5: Q value

The water quality at sampling station 5 was Q4-5. This stream also flows to the Clodiagh River. Fourteen taxa were recorded within the kick sample. Group A the most sensitive species were dominant with mayfly (*Heptageniidae spp.*) having the largest abundance being numerous within the sample. Taxa from this group also consisted of two species of stonefly (*Perla bipuncata*) and (*Nemouridae spp.*). Group B less sensitive species were numerous which included cased caddisfly species (*Trichoptera spp.*) making up the larger proportion of this group, with mayfly (*Baetidae spp.*) and stonefly (*Leuctra spp.*) having small numbers within the sample. Group C, relatively tolerant species included water shrimp (*Gammarus duebeni*), uncased caddisflys (*Trichoptera spp.*), black fly (*Simuliidae spp.*), water beetle (*Coleoptera spp.*), mayfly species (*Caenidae spp.*) and (*Ephemerellidae spp.*) with the latter having fair numbers within the overall sample. Limpet species were scarce within the sample but are not considered in the Q value scheme. Groups D and E the most tolerant species were not present. The silt plume test recorded slight siltation. Macrophytes included Moss species (*Sphagnum spp.*) and a slight growth of filamentous algae on boulders and cobbles. No emergent mocrophytes were observed along the sampling area. This would be normal in this area as stream flow was fast.

Sampling station 6: Q value

The water quality at sampling station 6 was Q3. This stream also flows to the Aughvana River and lies within the Shannon International River Basin District (SIRBD). Nine taxa were recorded within the kick sample. No Group A taxa were recorded within the sample. Two families of Group B taxa were recorded namely *Leuctra spp.* and *Trichoptera spp.* (cased). Of the these families *Trichoptera spp.* (cased) were the most common. The most common taxa recorded were from Group C with 6 families recorded dominated by the blackfly larvae (*Simuliidae spp.*) and to a lesser extent by the freshwater shrimp (*Gammarus duebeni*). A single limpet species was recorded within the sample but is not considered in the Q value scheme. Groups D and E the most tolerant species were not present. The silt plume test recorded slight siltation. Macrophytes included Moss species (*Sphagnum spp.*) and a slight growth of filamentous algae on boulders and cobbles. Sewage fungus was not observed at the sampling location and dissolved oxygen saturation had levels of 101.1%.

13.2.9.3 Physiochemical Water Quality

TABLE 13-18: PHYSIOCHEMICAL WATER QUALITY RECORDED AT THE UPPERCHURCH SITE, CO. TIPPERARY.

Parameter	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Salmonid Regulations S.I. No. 293 of 1988	Surface Water Regulations S.I. No. 272 of 2009
pH	7.5	7.6	7.2	7.7	7.6	7.7	>6 & <9	
Alkalinity, mg/L as CaCO3	72.5	62.9	91.1	81.0	56.6	119		
Temperature	11.28	11.98	10.03	12.29	12.46	12.10		
Suspended solids mg/L	3	2	6	<2	<2	18	<25	
BOD (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0	1.4	<5	<2.2
Nitrate(mg/L)NO3-N	1.08	0.73	2.07	1.23	0.65	1.95		
Nitrite (mg/L)NO2-N	<0.005	<0.005	<.005	<.005	<.005	0.01	<0.05	
Sulphate (mg/L)	5.14	4.85	5.70	4.78	4.56	4.36		
MRP, mg/L P	0.01	0.01	0.01	0.02	0.01	0.06		≤0.035
Total phosphorous P (mg/L)	0.09	<0.04	0.16	0.06	0.04	<0.04		
Total dissolved phosphorous P (mg/L)	0.09	<0.04	0.12	0.06	0.04	<0.04		
Particulate phosphorous (mg/L)	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04		

Ammonia	0.03	0.02	<0.02	0.03	0.02	<0.02	≤ 1	
Ammonia (unionised)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	≤ 0.02	
Metals								
Iron (mg/L)	0.251	0.146	0.025	0.089	0.110	0.16		
Aluminium (mg/L)	0.019	0.042	0.023	0.037	0.024	0.05		

Physiochemical water quality testing was undertaken at six sampling stations on six streams outside the immediate site that drain the study area on the 11th of June and 22nd of August 2012 to establish the baseline water quality of watercourses just downstream of the proposed windfarm infrastructure catchment area.

Dissolved oxygen levels were good in all the watercourses that were surveyed (>11mg/L), indicating that all of the surface waters in the catchment areas had levels of oxygen present capable of supporting healthy salmonid populations as per the Salmonid Water Regulations (SI No. 293 of 1988) implementing the Freshwater Fish Directive (78/659/EEC).

Levels of unionised ammonia and nitrite that are known to be particularly toxic to fish were within the thresholds specified in the Salmonid Regulations (S.I. No. 293 of 1988) at <0.02 and <0.005 respectively (see Table 13-18). Similarly the BOD levels were low with sites 1 through 5 inclusive, recording <1.0mg/L BOD and site 6 recording the highest levels; 1.4mg/L BOD. All sites were in compliance with the Salmonid Water Regulations (see Table 13-18).

Ortho-phosphate (MRP) levels were similar across sampling sites with 0.01mg/L levels recorded at sites 1, 2, 3 and 5 with site 4 recording 0.2mg/L and site 6 recording the highest levels of 0.06mg/L. Sites 1 through 5 levels are below the levels recommended in the Surface Water Regulations (S.I. No. 272 of 2009) meeting the requirements of the regulation, however site 6 exceeds the ≤0.035 recommended levels.

The suspended solid levels were also very low for streams 1 through 5, with levels recorded at <2mg/l at sampling stations 4 and 5. Sampling station 2 recorded 2mg/L. Sampling stations 1 and 3 were slightly higher with levels of 3mg/L and 6mg/L respectively. Sampling station 6 recorded the highest levels of 18 mg/L. The levels for sampling stations 1 and 6 follow the Q value results with these two streams having the lower Q values recorded. All streams were in compliance with the threshold of <25mg/l required under the Salmonid Water Regulations (S.I. No. 293 of 1988).

As the catchment is dominated by siliceous rocks the buffering capacity of water can change rapidly over the season especially when water levels are higher, resulting in the dilution of background mineral salts. As a result H+ ions are not easily neutralized, meaning a reduction in the pH. In addition rain water that is naturally low in pH (circa 5.5) can scavenge acidic ions from pine needles and peat and wash them into receiving water bodies causing local reductions in pH. The pH levels at all sampling stations range between 7.5 and 7.7. These fall within the threshold (>6 & <9) required under the Salmonid Water Regulations (S.I. No.

293 of 1988), required for balanced and healthy fish populations in the Salmonid Regulations.

13.2.10 Fish

13.2.10.1 Salmonids

There are two species of salmonid associated with freshwater habitats in Ireland Atlantic salmon (*Salmo salar*) and brown trout (*Salmo trutta fario*). The Atlantic salmon is listed as an Annex II species under the Habitat Directive. Atlantic salmon is a species of qualifying interest for the River Suir cSAC (site code: 002137) and the Lower River Shannon cSAC (site code: 002165). This is an anadromous species, living in freshwater for at least the first 2 or 3 years of life before migrating to sea. Relatively large cool rivers with extensive gravelly bottom headwaters are essential during their early life. Smolts migrate to sea, where they may live for 1 or 2 years before returning to freshwater. The species are unlikely to utilise waterways within the site boundary as they are quite shallow and small. A fisheries survey of the River Suir catchment carried out by the Regional Fisheries Board to establish the ecology of the River Suir and its tributaries found that all tributary catchments and the main channel itself supported salmon fry and parr. The survey noted that the sub-catchment of the Owenbeg branch of the upper Clodiagh had an important role in salmon production. In 2006 the River Suir was ranked as the fourth best 'Salmoid River' in Ireland.

13.2.10.2 Twaite Shad

Twaite shad spend their adult life at sea or in the lower reaches of estuaries and normally spawn near the tidal limits (NPWS, 2008). Weirs and dams are known to be obstacles to the migration of Twaite shad upstream. The current conservation status of the species is bad (NPWS, 2008). Because Favourable Reference Range Mapping for this species is only available in 50km grid cells the resolution is less fine than that which is available for other species. However, mapping of the Current Distribution of this species, which is available at 10km grid resolution, indicates that the species is not recorded within the Lower River Shannon cSAC and the species is not thought to spawn within the Lower River Shannon cSAC. The mapping also indicates that the species is confined to the lower reaches of the Suir system at a linear distance of in excess of 60km south east of the proposal site and separated from it by a watercourse of considerably greater length. Therefore on the basis of the distribution mapping, and the evidence sited in the site synopsis, it is considered unlikely that this species occurs within 15km of the proposed development. On the basis of the evidence outlined in this paragraph it is concluded that no significant impacts on this species, within either cSAC, are reasonably foreseeable as a result of the proposal considered in this document.

13.2.10.3 Allis shad

Allis shad spend their adult life at sea or in the lower reaches of estuaries, ascending to freshwater to spawn in early summer. The spawning females shed their eggs into the water where they either drop into the gravel bed or begin to drift downstream. Those eggs that fall into gravels hatch after several days and then drift downstream. The young fish may remain in estuarine waters during their second year before finally going to sea where they mature. While European populations have a recorded capacity for significant migration upstream, this capacity seems more constrained in Irish populations (King *et al.*, 2004). Weirs and dams are known to be obstacles to the migration of Allis shad upstream. The current conservation status of the species is 'Unknown' (NPWS, 2008). As Current Range mapping for this species is only available in 50km grid cells the resolution is less fine than that which is available for other species. However, mapping of the Current Distribution of this species, which is available at 10km grid resolution, indicates that the species is confined to the lower reaches of the Suir system (NPWS, 2008) which is a linear distance of in excess of 60km south east of the proposal site and separated from it by a watercourse of considerably greater length. Therefore, on the basis of the distribution mapping, and bearing in mind the constrained capacity for upstream migration referred to previously, it is considered unlikely that this species occurs within 15km of the proposed development. On the basis of the evidence outlined in this paragraph it is concluded that no significant impacts on this species, within the cSAC, are reasonably foreseeable as a result of the proposal considered in this document.

13.2.10.4River lamprey, brook lamprey and sea lamprey

Sea lampreys spend their adult life in marine and estuarine waters, living as external parasites on other fish species. They migrate up rivers to spawn in areas of clean gravels. Once they have spawned, they die. After hatching, the young larvae settle in areas of fine sediment in still water, where they burrow. They live as filter feeders and may remain in fine sediments for several years before transforming into adult fish. Sea lamprey, which can grow up to 1m in length, are widely distributed around the coast of Ireland. However they tend to occur in low densities. Overall, the conservation status of the sea lamprey in Ireland is considered to be poor (NPWS, 2008).

The river lamprey grows to 30cm and has a similar life history to the sea lamprey. The brook lamprey is the smallest of the three lampreys native to Ireland at 15 to 20cm. It is also the only one of the three which is non-parasitic and spends all its life in freshwater. Despite the difference in ecology, brook and river lamprey are very similar genetically and cannot be distinguished by visual means. Juvenile river and brook lampreys cannot be discriminated and metamorphosed individuals can only be distinguished on the basis of dentition (King *et al.*, 2004). As a result, for the purposes of this assessment, the brook and river lampreys have been treated together. The current status and future prospects of these species in Ireland appears to be good (NPWS, 2008).

Currently no records are retained online at the National Biodiversity Data Centre for these species within the extended river systems of either cSAC. The current known distribution for these species includes the 10km squares within which the proposal considered in this document occurs and the grid squares which incorporate the extended river systems which drain to both cSACs. O Connor (2006) confirmed the presence of these species within the Multeen, upstream of its point of confluence with the Aughnaglanny River, at a site approximately 18km downstream of the proposal site. The same survey recorded these species on the Owenbeg and Clodiagh rivers at sites located up stream of their point of confluence which is situated approximately 9km downstream on the Owenbeg and 19km downstream on the Clodiagh.

It is presumed in light of the aforementioned evidence and on the basis of the precautionary principle, that these species are potentially present within the zone of impact influence of the proposal. There is a risk that the water quality of the local watercourses, that drain the site, could be impaired during the construction stage of the proposed wind farm. It is possible that this could impact negatively on lamprey within the Lower River Suir cSAC downstream of the proposal site.

13.2.11 Birds

13.2.11.1 Habitat Assessment of the Study Area

Improved agricultural grassland is the dominant habitat at the site and the surrounding area and is not considered suitable breeding habitat for hen harrier. However this habitat is considered suitable foraging habitats for wintering hen harrier.

13.2.11.2 Winter vantage point observations

Winter vantage point observations were carried out in order to assess the level of raptor activity and purpose at the development site between 15th November 2010 and 16th March 2011. These observations were carried out in accordance with NPWS hen harrier survey guidelines. Three (3) vantage point locations were selected in order to obtain maximum visibility of the site and habitats outside the site boundary.

Vantage point watches were of six (6) hours duration and the three vantage points were watched for a total of eighteen (18) hours per site visit. During the course of the survey from November 2010 to March 2011 the site was watched for a total of ninety (90) hours. The locations of the vantage points are illustrated in (See **Figure 13-7** at the end of this chapter)

13.2.11.3 Winter Hen Harrier Survey Results

There was one observation of hen harrier during the vantage point surveys carried out in the winter of 2010 and 2011.

The observation concerned an adult male, observed from VP-3 on the 19th January 2011. The bird was observed at the northeast part of the site in the townland of Knockaviltoge, foraging in a westerly direction for the most part, over improved agricultural grassland, approximately 3m above ground, for 180 seconds (See **Figure 13-10** at the end of this chapter).

13.2.11.4 Other Raptor Observations

In addition to the hen harrier observed, there were four observations of Kestrel *Falco tinnunculus* and one observation of Sparrowhawk *Accipiter nisus* during the course of the vantage point surveys. Their flight paths are illustrated in (See **Figure 13-10** at the end of this chapter).

13.2.11.5 Winter Transect Bird Counts and Other Bird Observations

Transect counts were undertaken on 19th January and 16th March 2011 at five locations across the site and their locations are illustrated in **Figure 13-8**. A total of 34 bird species were recorded during the winter transect counts in 2010/2011 and during the course of the vantage point surveys. The results are summarised in Table 13-19 below. Species highlighted in orange represent species that are species of European Conservation Concern. They are Amber-listed because of their unfavourable conservation status but not concentrated in Europe. The remaining species are Green-listed, species of favourable conservation status (Newton *et al*. 1999).

TABLE 13-19: RESULTS OF TRANSECT COUNTS AND OTHER BIRD OBSERVATIONS IN WINTER 2010/2011

Species	VP Survey November 2010	VP December 2010	VP Survey January 2011 and Transect Survey 1	VP Survey February 2011	VP Survey March 2011 and Transect Survey 2
Wood Pigeon ***Columba palumbus***	4	1	5	3	8
Meadow Pipit ***Anthus pratensis***	2	2	3	2	3
Skylark ***Alauda arvensis***			1		1
Rook ***Corvus frugilegus***	2		1		2
Jackdaw ***Corvus monedula***	2				5
Hooded Crow ***Corvus corone***	3	2	6	2	5
Raven ***Corvus corax***	1	3		1	
Magpie ***Pica pica***	1	2	2	1	1
Wren ***Troglodytes troglodytes***	1	1	2	1	3
Dunnock ***Prunella modularis***			1		
Hen Harrier ***Circus cyaneus***			1		
Sparrowhawk ***Accipiter nisus***			1		
Kestrel ***Falco tinnunculus***		1	1		2
Pheasant ***Phasianus colchicus***		1			1
Pied Wagtail ***Motacilla alba yarrelli***		1	2		1
Robin ***Erithacus rubecula***	1		5	1	4
Starling ***Sturnus vulgaris***			63		
Mistle Thrush ***Turdus viscivorus***					2

Species	VP Survey November 2010	VP December 2010	VP Survey January 2011 and Transect Survey 1	VP Survey February 2011	VP Survey March 2011 and Transect Survey 2
Fieldfare ***Turdus pilaris***			61		
Song Thrush ***Turdus philomelos***		1			1
Redwing ***Turdus iliacus***			6	2	
Blackbird ***Turdus merula***		3	2	1	2
Goldcrest ***Regulus regulus***	1		5		3
Great Tit ***Parus major***		1	1		1
Blue Tit ***Cyanistes caeruleus***		1			
Coal Tit ***Periparus ater***	1	1	9		7
Siskin ***Carduelis spinus***	7	1	15	2	12
Crossbill ***Loxia curvirostra***			4		8
Lesser Redpoll ***Carduelis cabaret***	4		4		6
Linnet ***Carduelis cannabina***	6		4		5
Goldfinch ***Carduelis carduelis***		4		2	
Chaffinch ***Fringilla coelebs***	8	23	16	7	8
Bullfinch ***Pyrrhula pyrrhula***			11	4	
Reed Bunting ***Emberiza schoeniclus***	1		4		2

The assemblage of species recorded in winter is typical of the habitats occurring at the site. Chaffinch was the commonest species observed at the site with resident birds supplemented by immigrants from Britain and mainland Europe. Relatively high numbers of Fieldfare and Starling observed in January 2011 possibly reflected the cold conditions experienced during this period. Five amber-listed species were observed during the course of the winter bird survey.

13.2.11.6Summer Hen Harrier Survey 2011

Vantage Point Observations

Vantage point observations were carried out in order to assess the level of raptor activity and purpose at the development site during the summer of 2011. These observations were carried out in accordance with NPWS hen harrier survey guidelines. The vantage point locations chosen for the summer hen harrier survey remained the same as those chosen for the winter hen harrier survey.

Vantage point watches were of six (6) hours duration and the three vantage points were watched for a total of eighteen (18) hours per site visit. During the course of the summer survey from April to July 2011 the site was watched for a total of seventy two (72) hours. The locations of the vantage points are illustrated at the end of this report.

Results

Summer Hen Harrier Survey Results

There was one observation of hen harrier during the vantage point surveys carried out in the summer of 2011.

The observation concerned a moulting adult female, observed from VP-2 on the 10th June 2011. The bird was observed at the southeast part of the site, foraging in a southerly and then a southeasterly direction, over improved agricultural grassland for approximately thirty seconds and second rotation forestry for approximately one hundred and fifty seconds, in the townland of Shevry (**Figure 13-10**).

There was no evidence of hen harriers breeding at the study site in the summer of 2011.

13.2.11.7Other Raptor Observations

In addition to the hen harrier observed, there were two observations of kestrel *Falco tinnunculus* and one observation of peregrine falcon *Falco peregrinus* during the course of the vantage point surveys. Their flight paths are illustrated in **Figure 13-10**.

13.2.11.8Summer Transect Bird Counts and Other Bird Observations

Transect counts were undertaken on 19th May and 12th July 2011 at the same five locations as the winter bird survey. A total of 37 bird species were recorded during the transect counts during the summer of 2011 and during the course of the vantage point surveys. The results are summarised in Table 13-20 below. Species highlighted in orange represent species that are species of European Conservation Concern. They are Amber-listed because of their unfavourable conservation status but not concentrated in Europe. The remaining species are Green-listed, species of favourable conservation status (Newton *et al*. 1999).

TABLE 13-20: RESULTS OF TRANSECT COUNTS AND OTHER BIRD OBSERVATIONS BIRD OBSERVATIONS IN SUMMER 2011.

Species	VP Survey April 2011	VP Survey May 2011 and Transect Survey 1	VP Survey June 2011	VP Survey July 2011 and Transect Survey 2
Wood Pigeon ***Columba palumbus***	2	4		5
Meadow Pipit ***Anthus pratensis***	2	5	9	11
Skylark ***Alauda arvensis***		2	1	3
Rook ***Corvus frugilegus***	6	9	13	12
Jackdaw ***Corvus monedula***	4	3	8	10
Hooded Crow ***Corvus corone***	4	3	6	5
Raven ***Corvus corax***	2	3	1	4
Magpie ***Pica pica***	1	4	3	2
Wren ***Troglodytes troglodytes***	4	2	6	8
Dunnock ***Prunella modularis***	1	3	2	3
Her Harrier ***Circus cyaneus***			1	
Peregrine Falcon ***Falco peregrinus***			1	
Kestrel ***Falco tinnunculus***		1	1	
Pheasant ***Phasianus colchicus***	1	1	1	2
Swallow ***Hirundo rustica***	6	18	8	22
Sand Martin ***Riparia riparia***	2			
Cuckoo ***Cuculus canorus***	3	4		
Whitethroat ***Sylvia communis***	4	6	4	7
Blackcap ***Sylvia atricapilla***	2	5	2	6
Willow Warbler ***Phylloscopus trochilus***	6	12	4	6

Species	VP Survey April 2011	VP Survey May 2011 and Transect Survey 1	VP Survey June 2011	VP Survey July 2011 and Transect Survey 2
Robin *Erithacus rubecula*	2	4	3	5
Starling *Sturnus vulgaris*				1
Stonechat *Saxicola torquata*	2	3	2	
Mistle Thrush *Turdus viscivorus*	1		1	2
Blackbird *Turdus merula*	2	5	4	4
Goldcrest *Regulus regulus*		6		8
Great Tit *Parus major*	1	4		6
Blue Tit *Cyanistes caeruleus*		5		9
Coal Tit *Periparus ater*		10		12
Siskin *Carduelis spinus*	1	6	1	7
Crossbill *Loxia curvirostra*		6		9
Lesser Redpoll *Carduelis cabaret*	3	7	3	12
Linnet *Carduelis cannabina*	1	6	`7	12
Goldfinch *Carduelis carduelis*		2	1	4
Chaffinch *Fringilla coelebs*	4	6	5	10
Bullfinch *Pyrrhula pyrrhula*			1	2
Reed Bunting *Emberiza schoeniclus*	1	2	2	2

The assemblage of species recorded in summer is typical of the habitats occurring at the proposed windfarm site. Bird activity appeared to be more evident in summer than in winter, with birds being more vocal and breeding activity more evident. Eight amber-listed species were observed during the course of the summer bird survey.

13.2.11.9Summary and Conclusions

MWP were commissioned by Ecopower Ltd. to carry out and report on hen harrier and breeding bird activity for a proposed wind farm 2km west of Upperchurch, Co. Tipperary.

Winter field surveys were carried out between November 2010 and March 2011 and summer field surveys were carried out between April and July 2011. Hen harrier vantage point surveys were conducted according to the National Parks & Wildlife Service for assessing the impact of proposed windfarm developments on hen harriers.

The survey work entailed the following:

- Winter and summer vantage point surveys to determine hen harrier usage at the proposed windfarm area

- Winter and summer transect bird surveys

The dominant habitats occurring at the proposed Upperchurch windfarm site is improved agricultural grassland and coniferous forest plantations.

Hen harrier surveys included a total of ninety (90) hours observation from 3 vantage points for the winter survey and seventy two (72) hours observation from the same vantage points for the summer bird survey.

There was one observation of an adult male hen harrier in January 2010, during the winter vantage point survey and one observation of an adult female hen harrier in June 2011, during the summer bird survey.

There was no evidence of hen harriers breeding at the study site in the summer of 2011.

The randomness and low number of hen harrier observations during the vantage point surveys in 2010 and 2011 suggests that the proposed windfarm site at Upperchurch is used infrequently by hen harriers.

A total of 34 bird species were recorded using the site during the winter bird survey, of which five species are amber listed.

A total of 37 bird species were recorded using the site during the summer bird survey, of which eight species are amber listed

13.2.12 Other Vertebrates

13.2.12.1Common lizard (*Lacerta vivipara*)

Common lizard (*Lacerta vivipara*) was not recorded during surveys within the study area. The heath and blanket bog habitats within the study site offer potential habitats for the species but these habitats are not extensive and are fragmented within the area mainly confined to small sections with improved agricultural land and forestry in between. Recent studies of the population of lizards in Ireland have indicated that bog habitats (15% of all habitats recorded) are very important for the species due to the large abundance of invertebrates that inhabit these areas (IWT, 2007).

13.2.12.2*Common frog* (*Rana temporaria*)

There were some scattered observations of common frog throughout the site. There were several records of frogs within the drains, bog holes, bog trenches and water filled depression within the site. The trenches and drains that occur on the proposed site offer potential breeding habitat for the species.

13.2.13 Invertebrates

13.2.13.1Freshwater pearl mussel (Margaritifera margaritifera)

Ireland is said to support up to 46% of the known populations of the freshwater pearl mussel (*Margaritifera margaritifera*) within the European Union (Shannon International River Basin District, 2009). The freshwater pearl mussel is listed under Annex II of the EU Habitats Directive and is one of the species for which the Lower River Shannon cSAC and the Lower River Suir cSAC has been designated. Freshwater pearl mussel is listed as critically endangered in the Republic of Ireland in the most recent review of local IUCN threat status of Irish molluscs. Its overall conservation status in Ireland is ‘Unfavourable’ (NPWS, 2008)

Freshwater pearl mussels have a complex life cycle. They mature between seven and 15 years of age and can have a prolonged fertile period lasting into old age. The larvae (glochidia) initially attach to the gills of salmonid fish hosts which provide nourishment, before they become large enough for independent development in the river bed. After excysting from host fish juvenile mussels survive in the interstices of the substrate, comprised of a stable combination of sand, gravels and cobbles, where good oxygen exchange occurs. A covering of fine silt may prevent this and cause heavy mortalities. In summary, the freshwater pearl mussel requires very high quality rivers with clean river beds and waters with very low levels of nutrients without artificially elevated levels of siltation.

Current distribution for this species in the Lower River Suir cSAC includes 10km grid squares R94 and S05 which incorporate the Clodiagh River into which first order stream adjacent to the proposal site drain. The distribution mapping also includes 10km grid squares S04, S02 and S01 which contain a significant stretch of the main channel of the Suir further downstream of the proposal site. In addition records from 2006, retained at the National Biodiversity Data Centre on line data resource, indicate that the species was then recorded in several locations on the Multeen River. An unnamed stream adjacent to the proposal site drains to the Turraheen River which in turn drains to the Multeen. The nearest record retained is for 1km grid square R9844 situated approximately 21km downstream of the proposal site. It is presumed in light of the aforementioned direct evidence and on the basis of the precautionary principle, that this species is potentially present within the zone of impact influence of the proposal.

With regard for the lower River Shannon cSAC, the published current distribution for this species does not include any 10km square which incorporates any stretch of river downstream of the location of the proposal considered in this document. Mapping of the distribution in this cSAC indicates that the species is restricted to the Feale system a separate tributary which drains to the Shannon Estuary via the Cashen River in North County Kerry. No records for the river system downstream of the proposal site are retained at the NBDC on line data resource. On the basis of the evidence outlined in this paragraph it is concluded that no impacts on this species, within the Lower River Shannon cSAC downstream of the proposal site, are reasonably foreseeable as a result of the proposed windfarm.

13.2.13.2 White-clawed crayfish (Austropotamobius pallipes)

The Lower River Suir cSAC and the Lower River Shannon cSAC are both designated for the protection of this species. In Ireland, the white-clawed crayfish most commonly occurs in small and medium-sized lakes, large rivers, streams and drains, wherever there is sufficient lime (Reynolds, 2007). The species prefers relatively cool temperatures and adequate dissolved oxygen and lime, although it is capable of tolerating significant fluctuations. Juveniles live among submerged tree-roots, gravel or aquatic plants, while larger crayfish need stones to hide under, or earthen banks in which to burrow. Crayfish show little activity during the winter period (December to March), spending most of their time torpid in refuges. They become more active when the water temperature increases. Females carry their eggs over winter attached in a dense cluster under their tails (Peay, 2003) and they require undisturbed shelter over a prolonged winter-spring period.

White-clawed crayfish eat a wide range of food including fallen leaves, aquatic vegetation, dead fish, aquatic invertebrates such as snails and caddis-fly larvae, and other dead or alive crayfish. They have a wide range of predators; juveniles are eaten by fish, birds and invertebrate predators while adults are taken by large predators such as heron, otter and mink. The crayfish try to avoid predation by hiding in refuges by day and coming out at night, when most birds and fish are resting.

The overall conservation status of the white-clawed crayfish in Ireland is poor, due to the reduction of range and the continuing pressures that it faces (NPWS, 2008).

The most recently published Current Range and Current Distribution mapping for this species includes both 10km grid squares (R95 and R96), which incorporate the proposal considered in this document. In addition, records retained at the NBDC include one location within the Turraheen system and several locations on the Owenbeg system all of which are downstream of the proposal site considered in this document. The record on the Turraheen is located approximately 8km downstream of the site. The nearest location on the Owenbeg is approximately 4km downstream of the site. O Connor (2007) noted that crayfish were abundant at Munroe Bridge which is situated on the Cromoge River which drains to Clodiagh at a point upstream of the point of confluence of the Clodiagh and Owenbeg. Taken together these various records indicate the strong likelihood of the presence of significant population(s) within the upper Clodiagh/Owenbeg system. It is presumed in light of the aforementioned direct evidence and on the basis of the precautionary principle, that this species is potentially present within the zone of impact influence of the proposal.

There is a risk that the water quality of the local watercourses, that drain the site, could be impaired during the construction stage of the proposed wind farm. It is possible that this could impact negatively on the white-clawed crayfish.

13.2.13.3Other invertebrates

The Large white, a butterfly species (*Pieris brassicae*) was recorded within the site on agricultural grassland in the western section of the site.

A drinker moth (*Euthrix potatoria*) was recorded where the wet heath intergrates with agricultural grassland, just north of T2 and a large amount of lycosid spiders were found throughout the site in all habitats. Other invertebrates recorded within the study area are caddis fly larvae (*Trichoptera spp.*), and mayfly (*Ephemeroptera spp.*).

13.2.14 Fauna Evaluation

Fauna have been evaluated below in Table 13-21 for their conservation importance based on Table 13-2 above.

TABLE 13-21: EVALUATION OF FAUNA

Species	Evaluation	Rationale	Key Ecological Receptor
Bats	National Importance	There were no roosts recorded within the study area however the mature tree-lines within and adjacent to the site offer potential roosting habitat for bats. Bats are Annex IV species under the EU Habitats' Directive and are also listed as protected species under the Irish Wildlife Act (Amendment) 2000. Although no evidence of roosting was found within the proposed Upperchurch site, the legal status and ecological sensitivity of these species merits their evaluation as nationally important species.	Yes
Fallow deer	High Local Importance	Evidence of fallow deer was not recorded within the study area. It is not likely that this species use the habitats within the Upperchurch site on a frequent basis due to high disturbance from agriculture and forestry.	Yes
Otter	National Importance	Evidence of otter was not found within the study area, however, the rivers and streams further downstream offer potential habitat for the species.	Yes
Badger	National Importance	Badger droppings were recorded at the base of a hedgerow in the south eastern section of the site. A trail was followed through a grassland field to the west of T7 towards the conifer plantation to the south. No Badger setts were recorded during time of survey.	Yes
Pine marten	National Importance	No evidence of pine marten was recorded during surveys within the site. This species was recorded in grid square R95 on the 17/07/2009 and in grid square R96 on the 14/11/2011 (source *Atlas of Mammals in Ireland 2010-2015*), This species is protected under the Wildlife (Amendment) Act (2000) and under Annex V of the Habitats Directive Pine martens inhabit forests of coniferous or mixed tree types but in the west of Ireland they can be found on open rocky areas which contain scrub with good ground cover. Pine martens are solitary territorial animals.. Male's territorial ranges can cover up to 80ha with females occupying areas up to 30ha	Yes
Irish stoat	National Importance	There was no evidence of this species recorded within the study area during field surveys. Irish stoat are protected under Wildlife (Amendment) Act (2000) and under the Berne Convention Appendix III. Irish stoats have adapted to a large number of different habitat types but prefer an area that provides some cover. These habitats occur within the site in the form of forestry, hedgerows,	Yes
Red fox	High Local Importance	Droppings and trails were recorded throughout the south eastern and western sections of the site.	Yes
Irish (mountain) hare	National Importance	Irish hare were recorded during ecological surveys north of turbine T11 and there are potential habitats throughout the study area. A record from NBDB indicates that an Irish hare was observed 1.9 km west and 3.3 km east of the study area.	Yes
Common frog	National Importance	Adult and juvenile frogs were observed within the site. This is a protected species under the Wildlife Act and under Annex V of the EU Habitats' Directive.	Yes
Common lizard	National importance	This species was not recorded during field surveys within the site. The site offers potential habitats where this species could utilise, such as heathland and bogland.	Yes

Species	Evaluation	Rationale	Key Ecological Receptor
Pygmy shrew	National importance	This species was recorded outside the site during bat transects. This species could avail of habitats such as coniferous forests and areas with good ground cover such as grasslands, heaths, hedgerows, peatlands	Yes
Atlantic salmon	National Importance	There is low potential habitat for Atlantic salmon within the small streams flowing through the site. However, there is potential habitat for the adult and juvenile salmon with potential spawning and nursery habitats of the Clodiagh, Owenbeg and the Turraheen rivers further downstream of the study area.	Yes
Lamprey spp.	National Importance	There is low potential habitat for Lamprey within the small streams flowing through the site. However, there is potential habitat for the adult and juvenile lamprey with potential spawning and nursery habitats of the Clodiagh, Owenbeg and the Turraheen rivers further downstream of the study area.	Yes
Twaite shad	National Importance	There is no potential habitat for Twaite shad within the small streams flowing through the site. However, there is potential habitat for the adult and juvenile fish with potential spawning and nursery habitats of the Clodiagh, Owenbeg and the Turraheen rivers further downstream of the study area.	Yes
Allis-shad	National Importance	Current distribution for this species which is available at 10 km resolution, indicates that this species is confined to the lower reaches of the Suir which is a linear distance of in excess of 60km south east of the proposal site and separated from it by a watercourse of considerably greater length. It is unlikely that this species occur within 15 km of the proposed development because of its constrained capacity for upstream migration, referred to previously. On the basis of the evidence outlined it is concluded that no significant impacts on this species, within the cSAC, are reasonably foreseeable as a result of the proposal considered in this document.	Yes
White-clawed crayfish	National Importance	There is low potential habitat for white-clawed crayfish within the small streams flowing through the site. However, there is potential habitat for the adult and juvenile crayfish with potential breeding habitats in the Clydagh River further downstream of the study area.	Yes
Freshwater pearl mussel	National Importance	There is low potential habitat for Freshwater pearl mussel within the small streams flowing through the site. However there is potential habitat for this species further downstream of the proposed development.	
Hen harrier	National Importance	Two observations were recorded in total within the site during ornithological surveys conducted during the breeding and winter period. There was no evidence of nesting within the site and the level of activity indicates that the site is of low importance for the species	Yes
Kestrel	County Importance	There were four observations of kestrel during winter surveys and two during breeding bird surveys. The species is considered unlikely to be breeding within the site but appear to using the site infrequently for foraging.	Yes

In summary, the bat species, Freshwater pearl mussel, White-clawed crayfish, Allis-shad, Twaite shad, Atlantic salmon and the hen harrier are of the greatest conservation value. There was evidence that badger, Irish hare, kestrel, pygmy shrew and common frog use the site. Other species which potential may utilise habitats within the site include common lizard, Irish (mountain) hare, Irish stoat, fallow deer, otter and pine marten.

13.3 POTENTIAL IMPACTS

13.3.1 Introduction

Windfarm developments are typically large developments that may potentially impact on the natural environment (habitats, flora, fauna, water quality and fisheries). For windfarm projects, the construction phase is likely to have the most significant effect. Impacts include surface run-off from roads and earth works particularly on peat. This section will identify in detail the impact of the construction and operational phases of the windfarm development on the local natural environment.

13.3.2 Construction Phase

The following are the main elements of the proposed windfarm construction:

13.3.2.1 Primary Construction Activities

The development is characterised by the following civil engineering works which will be undertaken to provide the necessary infrastructure to complete the wind farm:

- Excavation for the construction of 22 turbine bases with a minimum depth of 2.00m and 225m^2 plan area and hardstands with and excavation depth of 0.60m and 1,040m^2 plan area;
- Erection of 22 turbines with a hub height of up to 85m and a tip height of up to 126.60m;
- Construction of 8.0km of 5.00m wide new roads;
- Widening and upgrading of 3.6km of existing farm roads (average 2m widening);
- Construction of a surface water drainage system along the road edges;
- Importation of stone from local quarries for construction of access roads and hard standings;
- Construction of an electrical substation and the installation of associated equipment; and
- The laying of electrical cables between turbines and the substation compound.

13.3.3 Construction Impacts

The main construction impacts will be associated with the construction of these elements and are likely to include:

- Habitat removal due to construction
- Increased dust and pollutant levels from construction vehicles
- Increased noise levels from vehicular movement and construction

13.3.3.1 Designated Sites

An Appropriate Assessment has been undertaken to identify any potential impacts to Natura 2000 sites (SACs and SPAs) as a result of the proposed development. This assessment is required under Article 6 of the Habitats Directive (92/43/EEC) and such assessments, according to guidance, should be clearly distinguishable and identified within an environmental statement. For this reason a separate Appropriate Assessment was undertaken (see **Appendix 13-II** at the end of this chapter). In this section only the potential impacts to sites that are outside SPAs and SACs have been identified for assessment. Many NHA designations overlap with SAC and SPA designations, having been designated to protect the same ecological resource and for that reason impacts to these sites are addressed in the Appropriate Assessment. One NHA and six pNHAs were recorded within 10km of the Study Area.

Two sites lie within Natura 2000 site namely Inchinsquillib and Dowling's Woods pNHA and Inchinsquillib and Bilboa and Gortnageragh River valleys pNHA. Dowling's Woods pNHA is located within the Lower Suir SAC and lies 8.7 km to the south of the proposed site. The Bilboa and Gortnageragh River valleys pNHA lies 9.3 km to the south west of the site and is located within the Lower River Shannon SAC and is part of the Slievefelim to Silvermines Mountains SPA.

Sites that lie outside Natura 2000 sites include the Mauherslieve Bog NHA, Co. Tipperary (site code: 002385); Killavalla Wood pNHA Co. Tipperary (site code: 001178) Aughnaglanny Valley pNHA (site code: 000948) and Nenegh River Gorge pNHA Co. Tipperary (site code: 001133).

The Aughnaglanny Valley pNHA lies 5.9 km to the south of the proposed site. It is a semi-natural woodland in a steep-sided river. The Mauherslieve Bog NHA 4.6 km west of the proposed site contains a good example of sloping mountain blanket bog with most of the vegetation still intact. The Irish Red Data Book species, Irish Hare, occurs on the site. The Killavalla Wood pNHA occurs 8.6km north of the proposed windfarm site consists of a native woodland and has a moderate conservation value (Perrin *et al*, 2008).The Nenegh River Gorge pNHA which is a main cultural feature of the Templederry forest is located 5 km to the northwest. None of these three pNHAs and one NHA are linked to the proposed site either across land or by waterways and there is no impact envisaged as a result of the proposed development.

13.3.3.2 Impact to habitats

Habitats and fauna are listed in order of ecological importance i.e. habitats of National Importance shall be discussed firstly followed by habitats of County Importance, etc. Table 13-22 summarises the habitat loss as a result of the proposed development. Table 13-24 and Table 13-25 below assess the impacts using NRA criteria (see Table 13-2 and Table 13-3 above) of the proposed windfarm development on the sites' habitats and species of value during construction phase. Estimated areas and lengths of habitat removal are given where relevant.

The construction of access roads, foundations and hardstandings around the turbines will result in habitat damage and loss. The habitat loss will be the total area covered by the upgrading of existing farm roads and tracks. The construction of new access roads, plus the footprint of each of the twenty two proposed turbines and the windfarm substation compound and all other windfarm infrastructure. This is expected to amount to approximately 1.79 % of the proposed development site.

TABLE 13-22: TABLE SUMMARISING HABITAT LOSS AS A RESULT OF THE PROPOSED DEVELOPMENT.

Habitat	Selection as key ecological receptor	Total area of habitat (ha) within the study area.	Percentage of total habitat within the study area (%)	Area of habitat to be lost (ha).	Percentage of total habitat loss (%)
Improved Agricultural Grassland (GA1)	Yes	228.34	42.53	5.98	1.11
Wet Grassland (GS4)	Yes	19.94	3.71	0.5	0.09
Mosaic of Improved Grassland (GA1) & Wet Grassland (GS4)	Yes	11.44	2.13	0.3	0.06
Mosaic Wet Heath (HH3) & Upland Blanket Bog (PB3)	Yes	15.54	2.89	0.01	0.002
Acid Grassland (GS3)	Yes	20.34	4.68	0.57	0.11
Mosiac Upland Blanket Bog (PB3) & Acidic Grassland (GS3)	Yes	3.16	3.79	0.45	0.08
Upland Blanket Bog (PB2)	Yes	25.13	0.59	0	0
Coniferous Plantation (WD4)	No	202.2	37.66	1.18	0.22
Spoil and Bare Ground (ED2)	No	4.3	0.80	0.66	0.12
Buildings and Artificial Surfaces (BL3)	No	4.2	0.78	-	-
Neutral Grassland (GS1)	Yes	2.25	0.42	0	0.00
Total (ha) (excluding FW1, FW4, WL1 and WL2)		**536.84 ha**	**100%**	**9.65Ha**	**1.79%**

TABLE 13-23: SUMMARISING LINEAR LENGTH OF HABITAT LOST AS A RESULT OF THE PROPOSED DEVELOPMENT.

Habitat	Selection as key ecological receptor	Total linear length of habitat (meters) within the study area..	Percentage of total habitat within the study area (%)	Area of habitat to be lost (m).	Percentage of total habitat loss (%)
Eroding/Upland River (FW1)	Yes	1486.88	-	0	-
Drainage Ditches (FW4)	Yes	1258.5	-	48.1	-
Hedgerow (WL1)	Yes	24968.69	-	980.77	-
Treelines (WL2)	Yes	668.73	-	-	-

13.3.3.3Impacts on Fauna

The potential impact of wind turbines on fauna may be considered as:

- Loss of habitats / Alteration of habitats;
- Potential impairment of water quality due to construction works; and
- Disturbance and/or displacement of fauna.

Habitat Loss or Alteration:

The resultant loss of habitat will have a slight impact to fauna within the local area. The habitats lost within the footprint of the development are plentiful throughout the greater area.

There is the potential that aquatic habitats within the proposed site (i.e. waterways) maybe altered as a result of pollutants and/or sediment entering these systems. This potential impact is discussed further below.

Potential impairment of water quality due to construction works

The potential significant impacts of the proposed development on aquatic ecology (without mitigation) are summarised as follows:

- *Pollution of watercourses with suspended solids due to runoff of soil from construction areas:*
  In the absence of adequate mitigation measures, contamination of water courses with suspended solids may have the potential to impact on aquatic flora and fauna within the waterways downstream of the proposed site.
- *Pollution of watercourses with nutrients due to ground disturbance during construction.*
  The main potential sources of nutrient inputs to freshwater due to ground disturbance are from nutrients adsorbed or chemically bound to eroded suspended solids.
- *Pollution of watercourses with nutrients due to decomposition of plant material after vegetation clearance.*
- *Pollution of watercourses, during construction phase, with other substances such as fuels, lubricants, waste concrete, waste water from wash facilities, etc.*
- *Pollution of watercourses with surface drainage water from paved areas and road surfaces.*
  There is a risk of pollution of surface waters with hydrocarbons from paved areas after the construction is complete.

Displacement and/or disturbance to fauna

Another potential impact during construction is disturbance of breeding, sheltering or foraging species of fauna by human activity and the operation of machinery. Turbine erection and access road construction can take several months. Work taking place during the summer months could cause disturbance to breeding and could lead to temporary displacement of some species from the site during construction. It is expected that this effect would be temporary and would not extend beyond the construction phase.

TABLE 13-24: ECOLOGICAL IMPACT ASSESSMENT OF HABITATS SELECTED AS KEY ECOLOGICAL RECEPTORS DURING THE CONSTRUCTION PHASE (WITHOUT MITIGATION)

Habitat	**Evaluation**	**Construction impact**	**Magnitude**	**Duration**	**Reversibility**	**Timing / Frequency**	**Positive/ Negative**
Improved Agricultural Grassland (GA1)	Locally important (higher value)	There shall be habitat lost as a result of the proposed development. Approximately 42.53% of the proposed site is classified as this habitat the amount of habitat to be lost is 1.11% of the total site.	Low	Permanent	Irreversible	n/a	Negative
Wet Grassland (GS4)	Locally important (higher value)	There shall be a small amount of this habitat lost as a result of the proposed development. Approximately 3.71% of the proposed site is classified as this habitat. The amount of habitat to be lost is 0.09% of the total site.	Low	Permanent	Irreversible	n/a	Negative
Mosaic of Improved Grassland (GA1) & Wet Grassland (GS4)	Locally important (higher value)	There shall be a small amount of this habitat lost as a result of the proposed development. Approximately 2.13% of the proposed site is classified as this habitat. The amount of habitat to be lost is 0.06% of the total site.	Low	Permanent	Irreversible	n/a	Negative
Mosaic of Wet Heath (HH3) & Upland Blanket Bog (PB3)	Locally important (higher value)	There shall be no loss of the habitat as a result of the proposed development.	n/a	n/a	n/a	n/a	Neutral
Acid Grassland (GS3)	Locally important (higher value)	There shall be a small amount of this habitat lost as a result of the proposed development. Approximately 4.68% of the proposed site is classified as this habitat. The amount of habitat to be lost is 0.11% of the total site.	Low	Permanent	Irreversible	n/a	Negative
Upland Blanket Bog (PB2)	County importance	There shall be no loss of the habitat as a result of the proposed development.	n/a	n/a	n/a	n/a	Neutral
Mosaic Upland Blanket Bog (PB3) &	Locally important (higher value)	There shall be a small amount of this habitat lost as a result of the proposed development. Approximately 3.79%	Low	Permanent	Irreversible	n/a	Negative

Habitat	Evaluation	Construction impact	Magnitude	Duration	Reversibility	Timing / Frequency	Positive/ Negative
Acidic Grassland (GS3)		of the proposed site is classified as this habitat. The amount of habitat to be lost is 0.08% of the total site.					
Eroding/ Upland River (FW1)	County Importance	There is the potential without mitigation that chemicals and sediment used/produced during the construction phase entering rivers and streams within the site and reducing the quality of the habitat.	Medium	Temporary	Reversible	n/a	Negative
Hedgerows (WL1)	Locally important (higher value)	There shall be some direct habitat lost as a result of the proposed development. 980.77m of this habitat shall be removed during the development.	Low	Permanent	Irreversible	n/a	Negative
Drainage Ditches (FW4)	Locally important (higher value)	There shall some direct habitat lost as a result of the proposed development, with 48.1m being removed during the development.	Low	Permanent	Irreversible	n/a	Negative
Treelines (WL2)	Locally important (higher value)	There shall be no loss of the habitat as a result of the proposed development.	n/a	n/a	n/a	n/a	Neutral
Neutral Grassland (GS1)	Locally important (higher value)	There shall be no loss of the habitat as a result of the proposed development.	n/a	n/a	n/a	n/a	Neutral

TABLE 13-25: SUMMARY OF IMPACT SIGNIFICANCE AND CONFIDENCE LEVELS IN THE PREDICTED IMPACTS ON THE KEY HABITATS DURING THE CONSTRUCTION PHASE (WITHOUT MITIGATION)

Habitat	Characterisation of unmitigated impact on the feature	Significance without mitigation and confidence levels
Improved Agricultural Grassland (GA1)	There shall be a direct loss of habitat within the footprint of the development.	Although the construction impact will result in permanent, irreversible loss of improved agricultural grassland habitat, the extent is relatively low particularly as there is an abundance of this habitat within the region and the low ecological value of this habitat. Therefore, it is ***near certain*** that the impact on this habitat will ***not be significant.***
Wet Grassland (GS4)	There shall be a direct loss of habitat within the footprint of the development.	Although the construction impact will result in permanent, irreversible loss of wet grassland habitat, the quality of the habitat was low and the extent is relatively low particularly as there is an abundance of this habitat within the region. Therefore, it is ***near certain*** that the impact on this habitat will

Habitat	Characterisation of unmitigated impact on the feature	Significance without mitigation and confidence levels
		not be significant.
Mosaic of Improved Grassland (GA1) & Wet Grassland (GS4)	There shall be a direct loss of habitat within the footprint of the development.	Although the construction impact will result in permanent, irreversible loss of this habitat, the quality of the habitat was low and the extent is relatively low particularly as there is an abundance of this habitat within the region. Therefore, it is ***near certain*** that the impact on this habitat will ***not be significant.***
Acid Grassland (GS3)	There shall be a direct loss of habitat within the footprint of the development.	Although the construction impact will result in permanent, irreversible loss of acid grassland habitat, the quality of the habitat was low and the extent is relatively low particularly as there is an abundance of this habitat within the region. Therefore, it is ***near certain*** that the impact on this habitat will ***not be significant.***
Mosaic Upland Blanket Bog (PB3) & Acidic Grassland (GS3)	There shall be a direct loss of habitat within the footprint of the development.	Although the construction impact will result in a small percentage of permanent, irreversible loss of this habitat, it is ***near certain*** that the impact on this habitat will ***not be significant.***
Eroding/ Upland River (FW1)	There is the potential without mitigation that chemicals and sediment used/produced during the construction phase entering rivers and streams within the site and reducing the quality of the habitat.	Without mitigation it is ***probable*** that the impact would ***be significant***.
Drainage Ditches (FW4)	There shall be a direct loss of habitat within the footprint of the development.	The proposed development will result in the small permanent, irreversible loss of drainage ditches. However the extent is relatively low particularly as there is an abundance of this habitat within the region and a net gain will result in this habitat as a result of the installation of new drainage systems to facilitate the proposed development. Therefore, it is ***near certain*** that the impact on this habitat will ***not be significant.***
Hedgerows (WL1)	There shall be a direct loss of habitat within the footprint of the development.	The proposed development will result in the permanent, irreversible loss 980.77m of hedgerow habitat. However the extent is relatively low particularly as there is an abundance of this habitat and many of the hedgerows dividing fields have very little cover within the region. Therefore, it is ***near certain*** that the impact on this habitat will ***not be significant.***

TABLE 13-26: ECOLOGICAL IMPACT ON FAUNA DURING THE CONSTRUCTION PHASE (WITHOUT MITIGATION)

Fauna	Description of Construction Impact	Magnitude/ Extent	Duration	Reversibility	Timing / Frequency	Positive/ Negative
Bats	There shall be loss of potential foraging habitat	Low	Permanent	Reversible	Bats are most active	Negative

Fauna	Description of Construction Impact	Magnitude/ Extent	Duration	Reversibility	Timing / Frequency	Positive/ Negative
	within the site. However, this loss of habitat is not considered to be significant given the availability of extensive foraging habitat outside the site. Some noise and anthropogenic disturbance during construction may occur.				during the summer (May-Sept).	
Otter	There is the potential without mitigation for sediment and pollutants entering the stream and waterways within the site to be washed downstream reducing water quality within the sections of rivers and streams where otter may forage. An increase in sediment and pollutants entering the stream could potentially lead to an impact to aquatic species of prey on which otter feed.	Low	Temporary	Reversible	Likely to be present all year round.	Negative
Badger	Some noise and anthropogenic disturbance during the construction phase of the development. Loss of foraging habitat within the improved agricultural grassland in the south eastern section of the proposed site where a badger trail and droppings were observed.	Low	• Temporary disturbance • Permanent habitat loss	• Impact from disturbance is expected to be mostly reversible post construction • Habitat loss is irreversible	Likely to be present all year round	Negative
Pine marten	There shall be loss of potential suitable habitat, due to the loss of conifer plantation and disturbance during construction phase.	Low	• Temporary disturbance • Permanent habitat loss	• Habitat loss is irreversible	Likely to be present all year round	Negative
Red fox	There shall be loss of potential foraging habitat within the site. However, this loss of habitat is not considered to be significant given the availability of extensive foraging habitat outside the site. Some noise disturbance during the construction phase of the development.	Low	• Temporary disturbance • Permanent habitat loss	• Impact from disturbance is expected to be mostly reversible post construction • Habitat loss is irreversible	Likely to be present all year round	Negative
Irish stoat	There shall be loss of potential foraging habitat	Low	• Temporary disturbance	• Impact from disturbance is	Likely to be present	Negative

Fauna	Description of Construction Impact	Magnitude/ Extent	Duration	Reversibility	Timing / Frequency	Positive/ Negative
	within the site. However, this loss of habitat is not considered to be significant given the availability of extensive foraging habitat outside the site. Some noise disturbance during the construction phase of the development.		• Permanent habitat loss	expected to be mostly reversible post construction • Habitat loss is irreversible	all year round	
Irish (mountain) hare	There shall be loss of potential foraging habitat within the site. However, this loss of habitat is not considered to be significant given the availability of extensive foraging habitat outside the site. Some noise disturbance during the construction phase of the development.	Low	• Temporary disturbance • Permanent habitat loss	• Impact from disturbance is expected to be mostly reversible post construction • Habitat loss is irreversible	Likely to be present all year round	Negative
Pygmy shrew	There shall be loss of potential foraging habitat within the site. However, this loss of habitat is not considered to be significant given the availability of extensive foraging habitat outside the site. Some noise disturbance during the construction phase of the development.	Low	• Temporary disturbance • Permanent habitat loss	• Impact from disturbance is expected to be mostly reversible post construction • Habitat loss is irreversible	Likely to be present all year round	Negative
Common frog	Potential loss of habitat due to possible loss of pools and water filled depressions within the site. Some noise and anthropogenic disturbance during the construction phase of the development.	Low	• Temporary disturbance • Permanent habitat loss	• Impact from disturbance is expected to be mostly reversible post construction • Habitat loss is irreversible	Likely to be present all year round	Negative
Atlantic salmon	There is the potential without mitigation for sediment and pollutants entering the stream and waterways within the site to be washed downstream reducing water quality within the section of the stream where Atlantic salmon could occur. An increase in sediment entering the stream could potentially lead to the smothering of spawning	High	Temporary	Reversible	Likely to be present all year round. Spawning occurs between Oct and Feb.	Negative

Fauna	Description of Construction Impact	Magnitude/ Extent	Duration	Reversibility	Timing / Frequency	Positive/ Negative
	ground further downstream.					
Lamprey spp.	There is the potential without mitigation for sediment and pollutants entering the stream and waterways within the site to be washed downstream reducing water quality within the section of the stream where lamprey spp. could occur. An increase in sediment entering the stream could potentially lead to the smothering of spawning ground further downstream.	High	Temporary	Reversible	Likely to be present all year round.	Negative
Twaite shad	There is the potential without mitigation for sediment and pollutants entering the stream and waterways within the site to be washed downstream reducing water quality within the section of the stream where twaite shad could occur. An increase in sediment entering the stream could potentially lead to the smothering of spawning ground further downstream.	High	Temporary	Reversible	Likely to be present all year round.	Negative
Allis shad	There is the potential without mitigation for sediment and pollutants entering the stream and waterways within the site to be washed downstream reducing water quality within the section of the stream where allis shad could occur. An increase in sediment entering the stream could potentially lead to the smothering of spawning grounds further downstream.	High	Temporary	Reversible	Likely to be present all year round.	Negative
White-clawed crayfish	There is the potential without mitigation for sediment and pollutants entering the stream and waterways within the site to be washed downstream reducing water quality within the section of the stream where crayfish	High	Temporary	Reversible	Likely to be present all year round.	Negative

Fauna	Description of Construction Impact	Magnitude/ Extent	Duration	Reversibility	Timing / Frequency	Positive/ Negative
	could occur.					
Freshwater pearl mussel	There is the potential without mitigation for sediment and pollutants entering the stream and waterways within the site to be washed downstream reducing water quality within the section of the stream where freshwater pearl mussel could occur. An increase in sediment entering the stream could potentially lead to the smothering of spawning ground further downstream.	High	Temporary/ Long term	Reversible	Likely to be present all year round.	Negative
Hen harrier	Loss of foraging habitat due to habitat loss and displacement. Potential risk of collision.	Low	Permanent	Reversible	Likely to be present all year round.	Negative
Kestrel	Loss of foraging habitat due to habitat loss and displacement. Potential risk of collision.	Low	Permanent	Reversible	Likely to be present all year round.	Negative

TABLE 13-27: SUMMARY OF SIGNIFICANCE OF THE EXPECTED IMPACTS AND THEIR ASSOCIATED CONFIDENCE LEVELS ON KEY FAUNA SPECIES DURING THE CONSTRUCTION PHASE (WITHOUT MITIGATION)

Fauna	Characterisation of unmitigated construction impact on the feature	Significance without mitigation and confidence levels
Bats	Some loss of potential foraging habitat. There is the potential that bat species could be temporarily impacted by disturbance during construction.	It is ***probable*** that a negative impact to bats **will not be significant**.
Otter	There is the potential without mitigation for sediment and pollutants entering the stream and waterways within the site to be washed downstream reducing water quality within the section of the stream where otter forage. An increase in sediment and pollutants entering the stream could potentially lead to an impact to aquatic species of prey on which otter feed.	It is ***probable*** that a negative impact to otter **will not be significant**.
Badger	Some loss of potential foraging habitat. There is the potential that badgers could be temporarily impacted by disturbance during construction.	It is ***probable*** that a negative impact to badger **will not be significant**.
Irish (mountain) hare	Some noise disturbance during the construction phase of the development. Some loss of habitat within the footprint of the proposed windfarm.	It is ***probable*** that a negative impact to Irish (mountain) hare **will not be significant**.
Red fox	There shall be loss of potential foraging habitat within the site. However, this loss of habitat is not considered to be	It is ***near certain*** that a negative impact to the red fox

Fauna	Characterisation of unmitigated construction impact on the feature	Significance without mitigation and confidence levels
	significant given the availability of extensive foraging habitat outside the site. Some disturbance during the construction phase of the development.	**will not be significant**
Common frog	Potential loss of habitat due to loss of temporary pools / wet areas within the site. Some disturbance during the construction phase of the development.	It is ***probable*** that a negative impact to common frog **will not be significant**.
Atlantic salmon	There is the potential without mitigation for sediment and pollutants entering the small drains within the site to be washed downstream reducing water quality within the section of the stream where Atlantic salmon could potentially occur. An increase in sediment entering the stream could potential lead to the smothering of spawning ground further downstream.	It is ***probable*** that a negative impact to Atlantic salmon **will not be significant**.
Lamprey spp.	There is the potential without mitigation for sediment and pollutants entering the stream and waterways within the site to be washed downstream reducing water quality within the section of the stream where lamprey spp. could occur. An increase in sediment entering the stream could potentially lead to the smothering of spawning ground further downstream.	It is ***probable*** that a negative impact to lamprey spp. **will not be significant**.
Twaite shad	There is the potential without mitigation for sediment and pollutants entering the stream and waterways within the site to be washed downstream reducing water quality within the section of the stream where twaite shad could occur. An increase in sediment entering the stream could potentially lead to the smothering of spawning ground further downstream.	It is ***probable*** that a negative impact to twaite shad **will not be significant**.
Allis shad	There is the potential without mitigation for sediment and pollutants entering the stream and waterways within the site to be washed downstream reducing water quality within the section of the stream where allis shad could occur. An increase in sediment entering the stream could potentially lead to the smothering of spawning ground further downstream.	It is ***probable*** that a negative impact to allis shad **will not be significant**.
White-clawed crayfish	There is the potential without mitigation for sediment and pollutants entering the stream and waterways within the site to be washed downstream reducing water quality within the section of the stream where crayfish could occur.	It is ***probable*** that a negative impact to crayfish **will not be significant**.
Hen harrier	Loss of foraging habitat due to habitat loss and displacement. Potential risk of collision.	It is ***probable*** that a negative impact to hen harrier **will not be significant**.
Kestrel	Loss of foraging habitat due to habitat loss and displacement. Potential risk of collision.	It is ***probable*** that a negative impact to kestrel **will not be significant**.

13.3.4 Operational Phase

The operational phase will have a lesser impact on the local ecology than the construction phase. The following section outlines the potential risk to the local environment during the operational phase of the development.

13.3.4.1 Designated conservation sites

The operational phase of the proposed development will not have an impact upon NHAs not covered by other designations. The impact of the proposed windfarm on Natura 2000 sites (and indirectly on pNHAs covered by these designations) is discussed further in the Appropriate Assessment (see **Appendix 13-II** at the end of this chapter).

13.3.4.2 Habitats

There is the potential impact (without mitigation) to the water quality of the drains and streams within the site due to sediment erosion and runoff during the early operational phase. No further impact to habitats is expected during the operational phase of the windfarm.

13.3.4.3 Fauna

The main operational impacts of the windfarm will arise from the rotation of the wind turbine blades and, to a lesser extent, from occasional vehicular movement along access roads. The rotation of the blades is likely to result in displacement of local wildlife due to the avoidance of birds in particular of the area immediately around the turbines. In addition, the rotating blades present a potential collision hazard to the Hen harrier and to local bat species. The rotation of the blades of the turbines will result in increased noise levels which may cause disturbance to local wildlife.

<u>Collision Risk: Bats</u>

Collision risk is an issue in relation to bats, particularly in relation to *Myotis* spp. which exhibit swarming behaviour (JNCC, 2001). Natural England has produced guidance on the impacts of windfarms to bats (Natural England, 2012). In this guidance, they have assessed the risk of collision to different species and placed them into low, medium or high risk categories based on a number of factors such as flight patterns and foraging strategies. This risk assessment is summarised below in Table 13-28 where the information of species that occur in Ireland has been extracted. In contrast to JNCC (2001), Natural England has classified *Myotis* species as being at low risk of collision.

TABLE 13-28: ASSESSMENT OF THE LIKELY LEVEL OF RISK TO UK BAT SPECIES FROM COLLISION WITH WIND TURBINES (INFORMATION ON SPECIES THAT OCCUR IN IRELAND EXTRACTED). SOURCE: NATURAL ENGLAND (2012).

Risk of turbine impact			
Factor	**Low Risk**	**Medium Risk**	**High Risk**
Habitat preference	Bats preferring cluttered habitat	Bats able to exploit background cluttered space	Bats preferring to use open habitat
Echolocation characteristics	Short range High frequency Low intensity Detection distance ~15m	Intermediate – more plastic in their echolocation	Long range Low frequency High intensity Detection distance ~80m
Weight	Lightest	Medium	Heaviest
Wing shape	Low wing loading Low aspect ratio Broadest wings	Intermediate	High wing loading High aspect ratio Narrow wings
Flight speed	Slow	Intermediate	Fast
Flight behaviour and use of landscape	Manoeuvre well will travel in cluttered habitat Keeps close to vegetation Gaps may be avoided	Some flexibility	Less able to manoeuvre May avoid cluttered habitat Can get away from unsuitable habitat quickly Commute across open landscape
Hunting techniques	Hunt close to vegetation Exploit richer food sources in cluttered habitat Gleaners	Hunt in edge and gap habitat Aerial hawkers	Less able to exploit insect abundance in cluttered habitat Aerial hawker Feed in open
Migration	Local or regional movements	Regional migrant in some parts of range	Long-range migrant in some parts of range
Conclusion: Categorisation of Bat found in Ireland	***Myotis* species** **Long eared-bats** **Horseshoe bats**	**Common pipistrelle** **Soprano pipistrelle**	**Leisler's bat** **Nathusius' pipistrelle**

Given a relative population size for each species and the likely risk posed by turbines, it may be possible to determine the level of threat posed to populations of bats. Most effort should be expended on populations likely to be at high risk of collisions and that may be most threatened. Table 13-29 below lists the likely level of risk considering the population size in the UK. Species present in Ireland have been extracted from Natural England's list. It should be noted however that Leisler's bat are more common in Ireland due to the lack of competition from the Noctule bat which is absent from Ireland.

TABLE 13-29: ASSESSMENT OF THE LIKELY LEVEL OF RISK TO THE POPULATIONS OF UK BAT SPECIES FROM COLLISION WITH WIND TURBINES (INFORMATION ON SPECIES THAT OCCUR IN IRELAND EXTRACTED). SOURCE: NATURAL ENGLAND (2012).

Low Risk	**Medium Risk**	**High Risk**
Myotis species		Leisler's bat
Long-eared bats		Nathusius' pipistrelle
Horseshoe bats		
Common pipistrelle		

Soprano pipistrelle		

There was four species of bats recorded during transects around and through the proposed site. These were common pipistrelle, Soprano pipistrelle, the brown long eared bat and the *Myotis* species, of either a whiskered/Brandt's bat.

TABLE 13-30: ASSESSMENT OF THE LIKELY LEVEL OF RISK TO THE POPULATIONS OF BAT SPECIES FOUND AT THE PROPOSED WINDFARM SITE

Low Risk	**Medium Risk**	**High Risk**
Myotis species		
Long-eared bats		
Common pipistrelle		
Soprano pipistrelle		

Collision Risk: Birds

Collision risk behavioural observations of birds in relation to operational wind farms provide the basis of assessments of collision risk. Fixed point observations of flight behaviour, flight lines into, through, and out of the area and information about the birds' use of the area help to inform the environmental assessment of the proposed wind farm. Bird mortality may result from bird collision with turbine structures or turbine blades.

There are many examples illustrating bird collision with wind turbine rotor blades and significant mortality has been recorded at some areas. The best documented areas are Tarifa (Spain) and Altamont Pass (California). Collision risk depends on a range of factors including species, bird abundance, bird behaviour, weather, topography and wind farm design (Percival, 2003). The examples mentioned are from areas with very high numbers and densities of birds (particularly large birds such as raptors) and are located in known key migration routes.

The evidence to date indicates that the effects are extremely species and site specific. Not all species are equally sensitive to collision. Large birds such as raptors and wildfowl are considered to be at greater risk of collision due to their flight behaviour and mobility (Percival, 2003). Percival notes that in Ireland, wind farms are most likely to have a serious negative impact on birds in areas of high concentrations of seabirds, wintering wildfowl or breeding raptors.

Relatively little is known about collision as a threat to birds. One problem is that most studies rely on the number of corpses found, but this can be extremely unreliable, since it is known that corpses are quickly removed by predators. At a wind farm site in Co. Wexford, during post-construction monitoring of seabirds, it was found that 90% of bird corpses left out were removed in two days (private report for Hibernian Windpower, by Joe Adamson Senior Ornithologist with MWP).

Passerines

Collision by resident passerines is not considered to be a significant issue as their breeding activity is generally well below the height of rotor blades and the significance of the risk of collision is considered to be very low.

Birds of Prey

As aforementioned, hen harrier was observed on two occasions at Upperchurch during the course of the winter and summer raptor vantage point surveys. The randomness and low number of hen harrier observations during the vantage point surveys in 2010 and 2011 suggests that the proposed windfarm site 2km west of Upperchurch is used infrequently by hen harriers. The very low number of observations would suggest that the significance of the risk of collision as a result of the construction of the wind farm is considered very low.

Kestrel were recorded to frequent the site on an infrequent basis with six observation in total over the two seasons. Observations of kestrel at a windfarm in Co. Wexford showed that kestrel occasionally hunted within the study area. The potential for collision on this species, as a result of the wind farm construction, is considered to be not significant.

Disturbance or Displacement

There is evidence that wind turbines can displace or exclude some species, which effectively results in habitat loss for these birds. Percival (2003) cites studies which indicate that this is a problem for larger wildfowl and some raptors. Disturbance can depend on a range of issues including seasonal bird use, diurnal bird use, location, availability of alternative habitats, bird life cycle, flock size, habituation and turbine and wind farm specifications (Percival, 2003).

Available evidence suggests that breeding passerines are not adversely affected by the presence of wind turbines. For example, a German study found no effect on numbers or spatial distribution of skylarks within 1km of turbines (Drewitt and Langston, 2006).

No birds of prey were observed to breed within the development site. Whitfield and Madders (2006), suggest that most studies do not detect any significant displacement of raptor species by wind turbines.

Observations of cormorant at a wind farm site in Co. Wexford during post-construction seabird monitoring in 2003 showed that cormorants completely avoided the wind farm and flew around it in a wide berth when passing close to the wind farm. The wind farm had been operating for a year in 2003. Subsequent observations of cormorant at the same wind farm in summer 2010 showed that cormorants flew between turbines at rotor height or above. The birds observed in 2010 may have been some of the same birds observed in 2003 that have habituated to the new land marks or were birds born after 2003 that have always been familiar with the wind farm (pers. obs. Joe Adamson Senior Ornithologist MWP). The results of this survey indicate that while some birds may initially exhibit avoidance behaviour they will probably habituate to its existence in the environment over time.

Disturbance or Displacement: Other fauna

It is considered highly likely that once the construction phase of the proposed development has been completed all terrestrial fauna will utilise the habitats within the site within a short period of time. The newly cleared areas of forestry, drains and sediment ponds shall offer new potential habitat for many of these species.

The operational impacts are summarised below in Table 13-31 and Table 13-32. None of the habitats are expected to be impacted during the operation of the windfarm. Hence the impacts are focused on the key faunal species in the area.

TABLE 13-31: ECOLOGICAL IMPACT ON FAUNA DURING THE OPERATIONAL PHASE OF THE PROPOSED DEVELOPMENT (WITHOUT MITIGATION).

Fauna	**Description of Operational Impact**	**Magnitude/ Extent**	**Duration**	**Reversibility**	**Timing / Frequency**	**Positive/ Negative**
Bats	There is the potential risk of collision to bat species which fly through the site.	Medium	Permanent	Irreversible	Bats are active during the summer (May-Sept).	Negative
Otter	There is the potential without mitigation for sediment and pollutants entering the stream and waterways within the site to be washed downstream reducing water quality within the section of the stream where otter forage. An increase in sediment and pollutants entering these streams could potentially lead to an impact to aquatic species of prey on which otter feed.	Medium	Temporary	Reversible	Likely to be present downstream on the river all year round.	Negative
Badger	No impact is envisaged during the operational phase of the proposed development.	n/a	n/a	n/a	n/a	Neutral
Red fox	No impact is envisaged during the operational phase of the proposed development.	n/a	n/a	n/a	n/a	Neutral
Irish stoat	No impact is envisaged during the operational phase of the proposed development	n/a	n/a	n/a	n/a	Neutral
Pine marten	No impact is envisaged during the operational phase of the proposed development	n/a	n/a	n/a	n/a	Neutral
Irish (mountain) hare	No impact is envisaged during the operational phase of the proposed development.	n/a	n/a	n/a	n/a	Neutral
Pygmy shrew	No impact is envisaged during the operational phase of the proposed development.	n/a	n/a	n/a	n/a	Neutral
Common frog	No impact is envisaged during the operational phase of the proposed development.	n/a	n/a	n/a	n/a	Neutral

Fauna	Description of Operational Impact	Magnitude/ Extent	Duration	Reversibility	Timing / Frequency	Positive/ Negative
Atlantic salmon	There is the potential without mitigation during the early operational phase before exposed areas are re-vegetated for sediment and pollutants entering the stream and waterway within the site to be washed downstream reducing water quality within the section of the stream where Atlantic salmon occur. An increase in sediment entering the stream could potentially lead to the smothering of spawning grounds further downstream.	Medium	Temporary	Reversible	Likely to be present downstream on the river all year round. Spawning occurs between Oct and Feb.	Negative
Lamprey sp.	There is the potential without mitigation during the early operational phase before exposed areas are re-vegetated for sediment and pollutants entering the stream and waterway within the site to be washed downstream reducing water quality within the section of the stream where lamprey occur. An increase in sediment entering the stream could potentially lead to the smothering of spawning grounds further downstream.	Medium	Temporary	Reversible	Likely to be present downstream on the river all year round.	Negative

Fauna	Description of Operational Impact	Magnitude/ Extent	Duration	Reversibility	Timing / Frequency	Positive/ Negative
Twaite shad	There is the potential without mitigation during the early operational phase before exposed areas are re-vegetated for sediment and pollutants entering the stream and waterway within the site to be washed downstream reducing water quality within the section of the stream where Twaite shad occur. An increase in sediment entering the stream could potentially lead to the smothering of spawning grounds further downstream.	Medium	Temporary	Reversible	Likely to be present downstream on the river all year round.	Negative
Allis shad	There is the potential without mitigation during the early operational phase before exposed areas are re-vegetated for sediment and pollutants entering the stream and waterway within the site to be washed downstream reducing water quality within the section of the stream where Allis shad might occur. An increase in sediment entering the stream could potentially lead to the smothering of spawning grounds further downstream	Medium	Temporary	Reversible	Likely to be present downstream on the river all year round.	Negative

Fauna	Description of Operational Impact	Magnitude/ Extent	Duration	Reversibility	Timing / Frequency	Positive/ Negative
White-clawed crayfish	There is the potential without mitigation during the early operational phase before exposed areas are re-vegetated for sediment and pollutants entering the stream and waterway within the site to be washed downstream reducing water quality within the section of the stream where crayfish occur.	Medium	Temporary	Reversible	Likely to be present downstream on the river all year round.	Negative
Freshwater pearl mussel	There is the potential without mitigation during the early operational phase before exposed areas are re-vegetated for sediment and pollutants entering the stream and waterway within the site to be washed downstream reducing water quality within the section of the stream where pearl mussel occur.	Medium	Temporary	Reversible	Likely to be present downstream on the river all year round.	Negative
Hen harrier	There is the potential risk of collision to bird species which fly through or utilise habitat within the site.	Low	Permanent	Irreversible	Likely to be present all year round.	Negative
Kestrel	There is the potential risk of collision to bird species which fly through or utilise habitat within the site.	Very Low	Permanent	Irreversible	Likely to be present all year round.	Negative

TABLE 13-32: SUMMARY OF SIGNIFICANCE IN THE EXPECTED IMPACTS DURING THE OPERATIONAL PHASE AND THEIR ASSOCIATED CONFIDENCE LEVELS ON KEY FAUNA SPECIES DURING THE OPERATIONAL PHASE (WITHOUT MITIGATION).

Fauna	Characterisation of unmitigated operational impact on the feature	Significance without mitigation and confidence levels
Bats	There is the potential risk of collision with bat species which fly through the site.	It is ***probable*** that a negative impact to bats **will not be significant**.
Otter	There is the potential without mitigation for sediment and pollutants entering the stream and waterways within the site to be washed downstream reducing water quality within the section of the stream where otter forage. An increase in sediment and pollutants entering these streams could potentially lead to an impact to aquatic species of prey on which otter feed.	It is considered ***probable*** that a negative impact to the otter **will not be significant**.
Atlantic salmon	There is the potential without mitigation during the early operational phase before exposed areas are re-vegetated for sediment and pollutants entering the stream and waterway within the site to be washed downstream reducing water quality within the section of the stream where Atlantic salmon occur. An increase in sediment entering the stream could potentially lead to the smothering of spawning grounds further downstream.	It is considered ***probable*** that a negative impact to the Atlantic salmon **will not be significant**.
Lamprey spp.	There is the potential without mitigation during the early operational phase before exposed areas are re-vegetated for sediment and pollutants entering the stream and waterway within the site to be washed downstream reducing water quality within the section of the stream where lamprey occur. An increase in sediment entering the stream could potentially lead to the smothering of spawning grounds further downstream.	It is considered ***probable*** that a negative impact to the lamprey **will not be significant**.
Twaite shad	There is the potential without mitigation during the early operational phase before exposed areas are re-vegetated for sediment and pollutants entering the stream and waterway within the site to be washed downstream reducing water quality within the section of the stream where Twaite shad occur. An increase in sediment entering the stream could potentially lead to the smothering of spawning grounds further downstream.	It is considered ***probable*** that a negative impact to the Twaite shad **will not be significant**.
Twaite shad	There is the potential without mitigation during the early operational phase before exposed areas are re-vegetated for sediment and pollutants entering the stream and waterway within the site to be washed downstream reducing water quality within the section of the stream where Twaite shad occur. An increase in sediment entering the stream could potentially lead to the smothering of spawning grounds further downstream.	It is considered ***probable*** that a negative impact to the Twaite shad **will not be significant**.
White-clawed crayfish	There is the potential without mitigation during the early operational phase before exposed areas are re-vegetated for sediment and pollutants entering the stream and waterways within the site to be washed downstream reducing water quality within the section of the stream where white-clawed crayfish could occur. An increase in sediment entering the stream could potentially lead to the smothering of young crayfish further downstream.	It is considered ***probable*** that a negative impact to the white-clawed crayfish **will not be significant**
Freshwater pearl	There is the potential without mitigation during the early operational phase before exposed areas are re-vegetated for	It is considered ***probable*** that a negative impact to the

Fauna	Characterisation of unmitigated operational impact on the feature	Significance without mitigation and confidence levels
mussel	sediment and pollutants entering the stream and waterways within the site to be washed downstream reducing water quality within the section of the stream where freshwater pearl mussel could occur.	freshwater pearl mussel **will not be significant**
Hen harrier	There is the potential risk of collision to hen harriers which fly through or utilise habitat within the site.	It is ***probable*** that a negative impact to hen harrier **will not be significant**.
Kestrel	There is the potential risk of collision to kestrels which fly through or utilise habitat within the site.	It is ***probable*** that a negative impact to kestrel **will not be significant**.

13.3.5 Cumulative Impact

The EC (2001) guidelines on the provision of Article 6 of the Habitats' Directive state that the phrase 'in combination with other plans or projects' in Article 3(3) of the Habitats Directive refers to the cumulative impacts due to plans or projects 'that are currently under consideration together with the effects of any existing or proposed projects or plans.' According to the Scottish Natural Heritage, '*the cumulative effect of a set of developments is the combined effect of all the developments, taken together'* (SNH, 2005).

A cumulative impact arises from incremental changes caused by other past, present or reasonably foreseeable actions together with the proposed windfarm development. The surrounding environment is dominated by agricultural land, conifer plantation and some peatland.

The main damaging operations and threats to the greater regions ecological resources are agriculture, overgrazing and afforestation. Extensive land reclamation has been carried out in this area in the recent past. The area has come under major disturbance by man. Afforestation also threatens the site. Forestry affects habitat uniformity, lake and river catchments, nesting and feeding habitats for animals, and landscape integrity. Overgrazing by cattle is also another problem, with many of the acidic grassland habitats and semi improved areas being over grazed, with erosion of shallow peat ensuing. The above operations are the most extensive but other threats and potentially damaging operations to valuable habitats include land drainage, fertilization, previous quarrying and some dumping that was seen just outside the proposed site. There are 10 windfarms in the vicinity of the proposed development. The proposed development will not add to these damaging operations and threats.

13.3.5.1 Other windfarms

There are a number of operating, permitted and windfarms that are currently under construction in the vicinity of the proposed Upperchurch windfarm site. These windfarm sites have received planning permission or an extension to duration of planning permission within the last 5 years or are in construction or are in operation. (See **Figure 13-9: Permitted and Existing Windfarms in the Area**)

Falleennafinoga Windfarm is a 2-turbine development at Turraheen Upper which is 2km south of the proposed site in South Tipperary. Construction has commenced on this project.
Hollyford Windfarm is a 3-turbine development at Glenough Upper which is 2km south of the proposed site in South Tipperary. Construction has not yet commenced on this project.
Glenough Windfarm is an operating windfarm of 13 turbines at Glenough Upper/Lower and Turraheen Upper/Lower which is located 3km to the southeast of the proposed site in South Tipperary. This windfarm was commissioned during 2011. Planning permission was granted in 2011, for a 1-turbine extension to the windfarm. Construction commenced on this turbine in August 2012.

Glencarbry Windfarm is a 9-turbine development at Glencarbry/ Piperhill/ Glenpaudeen/ Foilmacduff/ Glenough Lower which is 6km south of the proposed site in South Tipperary. Construction commenced on this project in August 2012.
Cappawhite Windfarm 8-turbine development, which was later combined with permission for 10 turbines, at Cappagh, Parkroe, Kilmore, Oldcastle and Moher which is 10km to the southwest of the proposed site in South Tipperary. Construction has not yet commenced on this project.
Garracummer Windfarm is a 13-turbine development at Curraghmarky, Birchgrove, Moanvaun, Garracummer, Cummer More and Cummer Beg which was later combined with permission for 2 turbines at Tooreen. This area is 4km southwest of the proposed site in South Tipperary. Construction commenced on this project in 2011.
Mienvee Windfarm is an operational windfarm of 1 wind turbine at Parkroe, 9km South West of the Site in South Tipperary.
Knockastanna Windfarm is an operational windfarm of 4 wind turbines at Curraghafoil, Doon, which is 8.1km to the soutwest of the proposed site in County Limerick.
Knockmeale Windfarm was granted Planning permission for 2 turbines at Lisgarriff, Knockmeale. in 2009. This area is 7km north west of the proposed site in North Tipperary. Construction has not yet commenced on this project.
Curraghgraigue Windfarm was extended to 6-turbines. This area is 9km north west of the proposed site in North Tipperary. This windfarm is operational.
It is considered that a negative cumulative impact to habitats is ***unlikely to be significant***.
:

Table 13-33 below presents windfarms that are in operation, being constructed or permitted within the Upperchurch area and greater surroundings.

TABLE 13-33: NEIGHBOURING WINDFARMS IN THE VICINITY, EXISTING AND PERMITTED.

Windfarm	**Number of Turbines**	**Distance and direction from proposed site**	**Status**
Knockastanna, Co Limerick	4	8.1km S	Operating
Mienvee	1	9km SW	Operating
Garracummer	15	3.5km SW	In Construction
Falleennafinoga	2	5.5km S	In Construction
Hollyford	3	5.5km S	Permitted
Glencarbry	9	6.3kn S	Permitted
Glenough	14	3.2kn S	Operating
Cappagh White	18	8.5km S	Permitted
Curraghgraigue	6	9.5km N	Operating
Knockmeale	2	8.2km NW	Permitted
Knockastanna, Co Limerick	4	8.1km S	Operating

13.3.5.2 Peat extraction

There is evidence that peat extraction has occurred in this region in the past. The expected ecological impacts from this activity would be loss of and alteration of habitat. This can be seen in the south eastern section just to the west of Turbine 3 where an area of blanket bog exists with banks of up to 1.2m in depth. Also to the north of Turbine 19 a larger area and good example of this habitat remains with banks of the same size. The drainage and cutting associated with peat extraction has in the past resulted in loss of intact Upland blanket bog which is likely to have dominated the area before human activities altered the region. The expected ecological impacts from this activity would be loss of and alteration of habitat. The resultant activity has led to the habitat alteration and shallow peat depths. The peat extraction impacts have led to recolonised areas of damaged or bare peat to be altered from its original habitat. The predominant resulting habitats are acidic grassland, wet heath and wet grassland. The main potential impacts of the proposed windfarm are habitat loss, habitat alteration and disturbance to wildlife. With such a small proportion of these habitats remaining and all proposed Turbine locations staying clear of these areas further drainage to this habitat will be avoided. It is considered that a negative cumulative impact to habitats is ***unlikely to be significant***.

13.3.5.3 Forestry

A relatively small proportion of the proposed site is under conifer plantation, with all sections of the site having areas of either mature or young conifer plantations. One of the impacts of this on the local environment is habitat loss, habitat alteration and potential reduction in water quality. Historically, it can be assumed that the forestry in the area has resulted in a loss of degraded Upland blanket bog and most likely other peatland habitats such as wet heath. This would have also reduced the habitat available for certain fauna species. While forestry may have resulted in a reduction in water quality within the site water quality in the surrounding catchment supports good status as dictated by the Water Framework Directive.

There is potential for the proposed windfarm to contribute to a cumulative impact on water quality in local watercourses within and downstream of the site through the potential of sedimentation and other pollutants entering the watercourses as a result of felling to accommodate new access track, construction activities and neighbouring forestry operations. It is considered that without proper mitigation a negative cumulative impact to water quality is ***unlikely to be significant***.

13.3.5.4 Farming

Agriculture is one of the main land uses within the area; there are large sections of improved agricultural grassland pastures for cattle in all sections of the site and the surrounding area. These fields have in the past been transformed by agricultural practices from bog, wet heath, wet grassland and acid grassland. The biodiversity of flora within these habitats have been reduced dramatically by drainage, reseeding, fertilisation and intensive grazing by cattle. The main potential impacts would be in terms of potential increase in nutrient levels of local watercourses. There is potential for the proposed windfarm to contribute to a cumulative impact on water quality in drains within the site and local watercourses further downstream of the site through the potential of sedimentation and other pollutants entering the watercourses as a result of felling, construction activities and farming operations. It is considered that without proper mitigation a negative cumulative impact to water quality is ***unlikely to be significant***.

13.4 MITIGATION MEASURES

13.4.1 Introduction

Construction of the windfarm is expected to cause a temporary (disturbance) adverse impact on the local ecology as outlined in the impact assessment in section 13.3 above. A number of planned mitigation measures detailed below will reduce these impacts significantly. Many of the mitigation measures below have been based on CIRIA technical guidance on water pollution control (Murnane, E., Heap, A., and Swain, A., 2006).

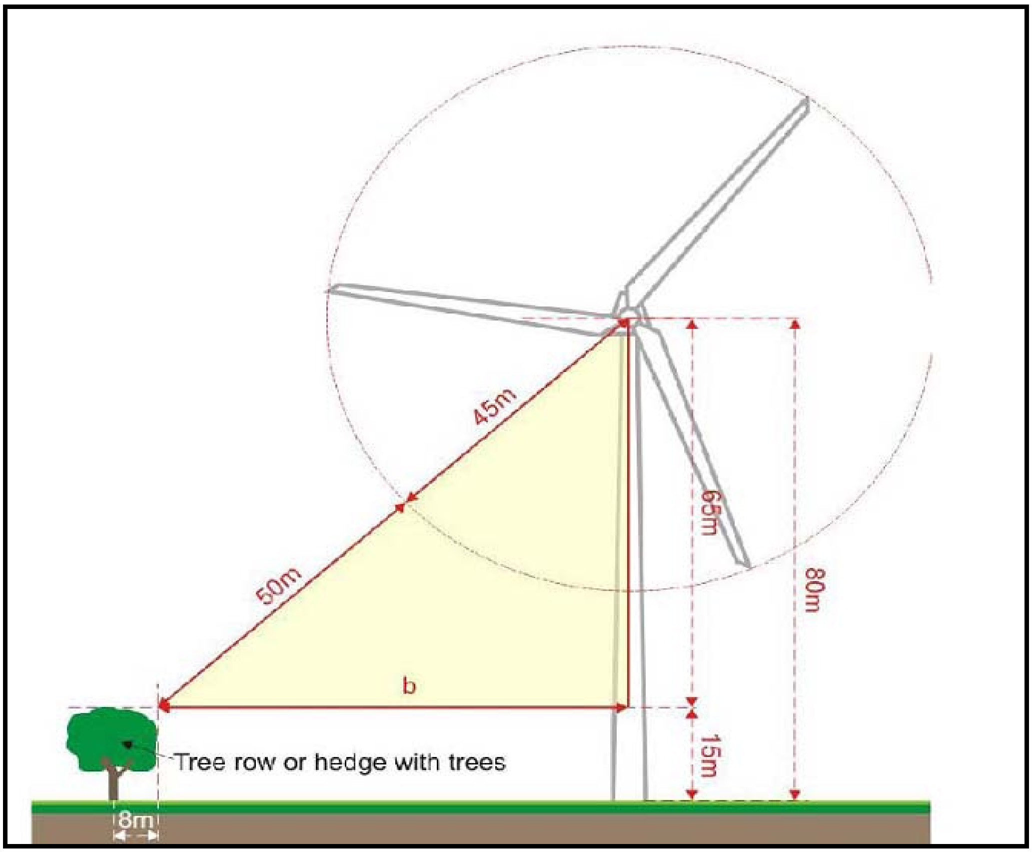
13.4.2 Mitigation by Design

The layout of the proposed windfarm has been designed to ensure that there is a sufficient buffer between windfarm infrastructure and the natural watercourses and streams within the study area.

The layout of turbines, access roads and other infrastructure associated with the proposed wind farm has been devised in order to minimise the risk to species of flora and fauna as a result of the proposed development. The layout of the turbines and the route of the access roads was also based on the results of site investigations, and for the most part the turbines and roads have been located on the least ecologically sensitive areas found during the investigations.

13.4.3 Mitigation Measures for Bats

Natural England (2012) has advised that predicted harm to bats could be minimised by altering locations of turbines within a site. According to Natural England (2012) "*To minimise risk to bat populations our advice is to maintain a 50 m buffer around any feature (trees, hedges) into which no part of the turbine intrudes. This means the edge of the rotor-swept area needs to be at least 50 m from the nearest part of the habitat feature. Therefore, 50 m should be the minimum stand-off distance from blade tip to the nearest feature. It is incorrect to measure 50 m from the turbine base to habitat feature at ground level as this would bring the blade tips very close to the canopy of a tall hedgerow tree and potentially put bat populations at risk. Instead, it is necessary to calculate the distance between the edge of the feature and the centre of the tower.*" These distances were taken into account during the design phase of the windfarm. The following formula was used:



$b = \sqrt{\{(50 + bl)^2 - (hh - fh)^2\}}$

where:
b = the distance on the ground between the edge of the canopy and the turbine (m)
bl = blade length (m)
hh = hub height (m)
fh = feature height (m)

Six of the 22 turbines (T3, T9, T12, T14 and T22) will require the felling of some conifer plantation for the installation of turbine and or hardstanding areas. While enclosed conifer plantations are of low value to bat species, the area of clear-felling required was calculated using the recommended formula. It is recommended that this distance be taken into account when applying for the felling licence should the proposed windfarm receive planning. The calculations are shown below give an example of the recommended distance for felling of tree within a plantation with an average tree height of 5m:

$b = \sqrt{\{(50 + 45)^2 - (80 - 15)^2\}}$

$b = \sqrt{4800}$

$b = 69.3m$

Hedgerows in close proximity to wind turbines will be removed to reduce the risk of bats potentially commuting and foraging along these linear features being drawn into the sweeping distance of turbine blades. The amount of hedgerow removal required will be identified by the project ecologist prior to construction. Hedgerow removal is discussed further in section 13.4.12. The following mitigation measures will be carried out to increase the value of the study area for bats:

- Native species (including hawthorn, blackthorn, hazel and oak) will be planted within new hedgerows to increase their value as foraging habitat to bats. Native species offer higher quality habitat for invertebrates the main prey item for bat species. All planting and hedgerow reinstatement will be carried out following the guidelines and recommended methodology reference in Knowles, (1995) and JNCC, (2001).

- Gaps within existing hedgerows shall be planted with native species to encourage the use of hedgerows as flight paths.

13.4.4 Runoff and Sediment Control

Mitigation measures shall be implemented to ensure that pollutants and sediment are not deposited within drains/streams which could be washed downstream during wetter periods. Erosion control where runoff is prevented from flowing across exposed ground and sediment control where runoff is slowed to allow suspended sediment to settle are important elements in runoff and sediment control. An erosion and sediment control plan has been prepared and will be implemented (see Chapter 15 Hydrological and Hydrogeological Impact Assessment – **Appendix 15-I Sediment & Erosion Control Plan**) to prevent sediment and pollutant runoff into the river during the construction phase. The plan will:

- Implement erosion control to prevent runoff flowing across exposed ground and becoming polluted by sediments;
- Intercept and divert clean water runoff away from construction site runoff to avoid cross-contamination of clean water with soiled water;
- Implement sediment control to slow down runoff allowing suspended sediments to settle in situ particularly on roads;
- When working at each stage and section (e.g. access road, each turbine base, etc) of the development the associated erosion and sediment controls at each section will be put in place prior to construction of each section of road. Access roads will need to be constructed to access the proposed site for drains, sediment traps and settling ponds. The associated erosion and sediment controls will be constructed alongside these roads and in a conscious manner to ensure that the potential risk to water quality is minimised;
- Minimise area of exposed ground by maintaining existing vegetation that would otherwise be subject to erosion in the vicinity of the windfarm infrastructure and keeping excavated areas to a minimum;
- Avoid working near watercourses during or after prolonged rainfall or an intense rainfall event and cease work entirely near drains when it is evident that pollution is occurring;

- Install a series of silt fences or other appropriate silt retention measure where there is a risk of erosion runoff to watercourses from construction related activity particularly if working during prolonged wet weather period or if working during intense rainfall event;
- Implement sediment control measures that includes for the prevention of runoff from adjacent intact ground that is for the separation of clean and 'dirty' water;
- Install appropriate silt control measures such as silt-traps, check dams and sedimentation ponds;
- Provide recommendations for public road cleaning where needed particularly in the vicinity of drains; and
- Controls need to be regularly inspected and maintained otherwise a failure may result, such as a build up of silt or tear in a fence, which will lead to water pollution so controls must work well until the vegetation has re-established; inspection and maintenance is critical after prolonged or intense rainfall.

13.4.5 Fuel and Oil

It is also recommended to implement a fuel management plan which should incorporate the following elements:

- Mobile bowsers, tanks and drums should be stored in secure, impermeable storage area, away from drains and open water;
- Fuel containers must be stored within a secondary containment system e.g. bund for static tanks or a drip tray for mobile stores;
- Ancillary equipment such as hoses, pipes must be contained within the bund;
- Taps, nozzles or valves must be fitted with a lock system;
- Fuel and oil stores including tanks and drums should be regularly inspected for leaks and signs of damage;
- Only designated trained operators should be authorised to refuel plant on site and emergency spill kits will be present at equipment for all refuelling events;
- Procedures and contingency plans need to be set up to deal with an emergency accidents or spills; and
- An emergency spill kit with oil boom, absorbers etc. is to be kept on site in the event of an accidental spill.

13.4.6 Wheel Wash, Dewatering and Concrete

In order to reduce the potential for the roads to the south and east of the site being dirtied by heavy vehicle traffic, it is recommended that a wheel wash area is provided and the resultant waste water is diverted to a siltation pond for settling out of solids. It is important that any pumping dewatering system is well planned and pumped water will need to be treated in the adequate settlement pond and silt trap. It is important to prevent concrete from entering waterways within and in close proximity to the site and always to prevent it entering watercourses. Concrete will be used for construction of the turbine foundations and the site control building and the following measures should be implemented:

- Designate a concrete washout area away from drains and watercourses for washing out the chutes;
- Washout of concrete trucks should occur off site at a designated, contained impermeable area;

- A designated trained operator experienced in working with concrete will be employed during the concrete pouring phase; and
- Large volumes of concrete water can be pumped into a skip to settle out; settled solids will need to be appropriately disposed of off-site. The total volume will be reduced by only permitting concrete chutes to be washed on site.

13.4.7 Habitats and Stream Crossing

There will be one new stream crossing required for the proposed development and a stream crossing method statement will be developed in consultation with the Inland Fisheries Ireland.

13.4.8 Felling

4.35 hectares of felling will take place of young conifer trees to facilitate the construction of the parts of the turbine foundation and hardstand areas for T3, T9, T12, T14 and T22. All associated tree felling will be undertaken using good working practices as outlined by the Forest Service in their 'Forestry Harvesting and Environment Guidelines' (2000a) and the 'Forestry and Water Quality Guidelines '(2000b). The latter guidelines deal with sensitive areas, erosion, buffer zone guidelines for aquatic zones, ground preparation and drainage, chemicals, fuel and machine oils.

All excess felled brash should be removed off site to avoid release and runoff of phosphorous into sensitive watercourses. pre-felling bird survey will be carried out prior to felling to ensure that potential nesting birds are not impact if felling is carried out within the breeding bird season (April to July).

13.4.9 Replanting and Reinstatement of Site

Exposed areas of the site that are slow to revegetate may need to be replanted with suitable vegetation. This will be decided by the developer in consultation with the project ecologist near the end of the construction phase.

As a result of permanent felling works areas surrounding the windfarm infrastructure will be bare and it is proposed to incorporate these areas into an Ecological Management Plan for the site (see section 13.4.10 below).

13.4.10 Ecological Management Plan

An Ecological Management Plan (EMP) will be developed prior to construction to provide a framework for the conservation and enhancement of valuable features within the site. The main emphasis of the programme of works will be on monitoring the impacts, if any, to the local aquatic ecology. Hence, the mitigation outlined above will be co-ordinated as part of the EMP. These are:

- Water Quality Measures
- Routine inspection and maintenance of sediment and erosion measures
- Water quality monitoring for years 1 and 2 of operation. Monitoring of water quality parameters will be conducted monthly in Year 1. If thresholds are not exceeded in Year 1, then the effort may be reduced in Year 2.
- A number of suitable sediment ponds will be retained in situ and may require modification to enhance the suitability of the site for invertebrates.
- The removal of excess brash and trees off site and disposal at an appropriate location to minimise nutrient leaching to the soil.
- The allowance for the natural establishment of wet grassland, scrub and possibly wet heath vegetation within the proposed site.
- Where natural establishment of vegetation is slow, purple-moor grass (*Molinia caerulea*) and other suitable species should be planted within the bare felled areas.

13.4.11 Lights on Turbines

It appears that the lighting on top of wind turbines may have an impact on the likelihood of bats colliding with turbines. Research on this topic, which is reviewed in Powelsland (2009), indicates that intermittent lighting is less likely to cause species to collide with turbines. The use of “white lights” on the turbines should be avoided as these can attract night flying birds such as migrants, and insects, which in turn can attract bats. Any form of lighting on the turbines or other structures will have to be agreed in advance with the Irish Aviation Authority.

13.4.12 Hedgerow Removal

Approximately 360m of hedgerows will be removed as part of the construction of infrastructure and mitigation measures to reduce the potential risk of bats colliding with turbines blades. As part of the proposed development approximately 360m of new hedgerow will be planted to mitigate this loss of habitat. Existing hedgerows in poor condition will be planted with native species to increase there ecological value. The location of new hedgerow shall be identified by the project ecologist prior to construction. Native species will be replanted within the proposed new hedgerows. A list of potential species is presented in Table 13-34 below.

TABLE 13-34: LIST OF SPECIES TO BE USED FOR NEW HEDGEROWS.

Common name	Latin name
Ash	*Fraxinus excelsior*
Bay Willow	*Salix pentandra*
Black Alder	*Alnus glutinosa*
Blackthorn/Sloe	*Prunus spinosa*
Crab apple	*Malus sylvestris*
Common/Wild Cherry	*Prunus avium*
Downey Birch	*Betula pubescens*
Goat Willow	*Salix caprea*
Grey Willow	*Salix atrocinerea*
Hawthorn	*Crataegus monogyna*
Mountain Ash/Rowan	*Sorbus aucuparia*
Pedunculate Oak	*Quercus robur*
Sessile Oak	*Quercus petraea*
Wych Elm	*Ulmus glabra*
Yew	*Taxus baccata*

13.5 RESIDUAL IMPACTS

Residual impacts are impacts that remain once mitigation has been implemented or that cannot be mitigated. Table 13-35 below provides a summary of the impact assessment for identified Habitats of National Importance Local Importance (higher value) which are the most ecologically valuable. Table 13-36 provides a summary of the residual impacts to fauna, and fisheries and water quality.

Provided all mitigation measures are implemented in full and remain effective throughout the construction phase, and given the low risk nature of the site, no significant residual impacts are expected from the development of Upperchurch Windfarm on the nearby designated nature conservation sites and local ecology.

TABLE 13-35: RESIDUAL IMPACTS OF THE WINDFARM DEVELOPMENT HABITATS THAT ARE CLASSIFIED AS KEY ECOLOGICAL RECEPTORS.

Habitat	**Evaluation**	**Characterisation of unmitigated impact**	**Significance of impact without mitigation**	**Mitigation**	**Residual impact**
Eroding/ Upland River	County Importance	There is the potential without mitigation that chemicals and sediment used/produced during the construction phase entering streams both within the site and further downstream reducing the quality of the habitat.	It is ***probable*** that the unmitigated impact would ***be significant***.	• Mitigation by design. • Erosion and sediment plan. • Implementation of a fuel management plan. • Control of wheel wash, dewatering and concrete. • The recommendation for the composition of an ecological management plan prior to construction.	A negative impact is ***extremely unlikely to be*** **significant.**

TABLE 13-36: RESIDUAL IMPACTS OF THE WINDFARM DEVELOPMENT ON FAUNA, AND FISHERIES AND WATER QUALITY

Species	Evaluation	Characterisation of unmitigated impact	Significance of impact without mitigation	Mitigation	Residual impact
Bats	National Importance	<u>Construction Phase</u> • Loss of foraging habitat • Temporary disturbance and/or displacement of species <u>Operational Phase</u> Risk of collision with turbines	<u>Construction Phase</u> It is ***probable*** that a negative impact to bats **will not be significant**. <u>Operational Phase</u> It is ***probable*** that a negative impact to bats **will not be significant**.	• Best practise methodology shall be adhered to for hedgerow removal and clear-felling. This shall ensure that the potential impact to bats within the site is minimised. • Lighting on turbines (not white lighting) • The management and planting of hedgerows within the study area	It is ***probable*** that a negative impact to bats **will not be significant**.
Otter	National Importance	<u>Construction Phase</u> • Potential without mitigation for reduction in water quality downstream of the development. <u>Operational Phase</u> • Potential without mitigation for reduction in water quality downstream of the development.	<u>Construction Phase</u> It is ***probable*** that a negative impact to otter **will not be significant**. <u>Operational Phase</u> It is ***probable*** that a negative impact to otter **will not be significant**.	Implementation of erosion and sediment plan and the fuel management plan.	It is ***near certain*** that a negative impact to otter **will not be significant**.
Badger	National Importance	<u>Construction Phase</u> • Loss of foraging habitat • Temporary disturbance and/or displacement of species <u>Operational Phase</u> No impact envisaged	<u>Construction Phase</u> It is ***near certain*** that a negative impact to badger **will not be significant.** <u>Operational Phase</u> No impact is envisaged.	Recommendation for the composition of an environmental management plan prior to construction.	It is ***near certain*** that a negative impact to badger **will not be significant.**
Red fox	High local importance	<u>Construction Phase</u> • Temporary disturbance and/or displacement of species • Loss of habitat <u>Operational Phase</u> No impact envisaged	<u>Construction Phase</u> It is ***near certain*** that a negative impact to the red fox **will not be significant.** <u>Operational Phase</u> No Impact is envisaged.	Recommendation for the composition of an environmental management plan prior to construction.	It is ***near certain*** that a negative impact to the red fox **will not be significant.**
Irish (mountain)	National Importance	<u>Construction Phase</u>	<u>Construction Phase</u> It is ***probable*** that a	Recommendation for the composition of an	It is ***probable*** that a

Species	Evaluation	Characterisation of unmitigated impact	Significance of impact without mitigation	Mitigation	Residual impact
hare		• Temporary disturbance and/or displacement of species • Loss of habitat Operational Phase No impact envisaged	negative impact to Irish (mountain) hare **will not be significant**. Operational Phase No Impact is envisaged.	environmental management plan prior to construction.	negative impact to Irish (mountain) hare **will not be significant**.
Common frog	National Importance	Construction Phase • Temporary disturbance and/or displacement of species • Loss of habitat Operational Phase No impact envisaged	Construction Phase It is ***probable*** that a negative impact to common frog **will not be significant.** Operational Phase No Impact is envisaged.	Recommendation for the composition of an environmental management plan prior to construction.	It is ***probable*** that a negative impact to common frog **will not be significant.**
Atlantic salmon	National Importance	Construction Phase • Potential without mitigation for reduction in water quality downstream of the development. Operational Phase • Potential without mitigation for reduction in water quality downstream of the development.	Construction Phase It is ***probable*** that a negative impact to Atlantic salmon **will not be significant**. Operational Phase It is ***probable*** that a negative impact to Atlantic salmon **will not be significant**.	Implementation of erosion and sediment plan and the fuel management plan.	It is ***near certain*** that a negative impact to the Atlantic salmon **will not be significant.**
Lamprey spp.	National Importance	Construction Phase • Potential without mitigation for reduction in water quality downstream of the development. Operational Phase • Potential without mitigation for reduction in water quality downstream of the development.	Construction Phase It is ***probable*** that a negative impact to lamprey spp. **will not be significant**. Operational Phase It is ***probable*** that a negative impact to lamprey spp. **will not be significant**.	Implementation of erosion and sediment plan and the fuel management plan.	It is ***near certain*** that a negative impact to the lamprey species **will not be significant.**
Twaite shad	National Importance	Construction Phase	Construction Phase It is ***probable*** that a	Implementation of erosion and sediment	It is ***near certain*** that a

Species	Evaluation	Characterisation of unmitigated impact	Significance of impact without mitigation	Mitigation	Residual impact
		• Potential without mitigation for reduction in water quality downstream of the development. Operational Phase • Potential without mitigation for reduction in water quality downstream of the development.	negative impact to twaite shad **will not be significant**. Operational Phase It is ***probable*** that a negative impact to twaite shad **will not be significant**.	plan and the fuel management plan.	negative impact to the twaite shad **will not be significant.**
Allis shad	National Importance	Construction Phase • Potential without mitigation for reduction in water quality downstream of the development. Operational Phase • Potential without mitigation for reduction in water quality downstream of the development.	Construction Phase It is ***probable*** that a negative impact to allis shad **will not be significant**. Operational Phase It is ***probable*** that a negative impact to allis shad **will not be significant**.	Implementation of erosion and sediment plan and the fuel management plan.	It is ***near certain*** that a negative impact to the allis shad **will not be significant.**
White-clawed crayfish	National Importance	Construction Phase • Potential without mitigation for reduction in water quality downstream of the development. Operational Phase • Potential without mitigation for reduction in water quality downstream of the development.	Construction Phase It is ***probable*** that a negative impact to crayfish **will not be significant**. Operational Phase It is ***probable*** that a negative impact to crayfish **will not be significant**.	Implementation of erosion and sediment plan and the fuel management plan.	It is ***near certain*** that a negative impact to the white-clawed crayfish **will not be significant.**
Freshwater pearl mussel	National Importance	Construction Phase • Potential without mitigation for	Construction Phase It is ***probable*** that a negative impact to freshwater pearl mussel **will not be**	Implementation of erosion and sediment plan and the fuel management plan.	It is ***near certain*** that a negative impact to the freshwater

Species	Evaluation	Characterisation of unmitigated impact	Significance of impact without mitigation	Mitigation	Residual impact
		reduction in water quality downstream of the development. Operational Phase • Potential without mitigation for reduction in water quality downstream of the development.	**significant**. Operational Phase It is ***probable*** that a negative impact to freshwater pearl mussel **will not be significant**.		pearl mussel **will not be significant.**
Hen harrier	National Importance	Construction Phase • Loss of foraging habitat • Temporary disturbance and/or displacement of species Operational Phase Risk of collision with turbines	Construction Phase It is ***probable*** that a negative impact to hen harrier **will not be significant**. Operational Phase It is ***probable*** that a negative impact to hen harrier **will not be significant**.	• Pre-felling bird surveys • Recommendation for the composition of an environmental management plan prior to construction.	It is ***probable*** that a negative impact to hen harrier **will not be significant**.
Kestrel	County Importance	Construction Phase • Loss of foraging habitat • Temporary disturbance and/or displacement of species Operational Phase Risk of collision with turbines	Construction Phase It is ***probable*** that a negative impact to kestrel **will not be significant**. Operational Phase It is ***probable*** that a negative impact to kestrel **will not be significant**.	• Pre-felling bird surveys • Recommendation for the composition of an environmental management plan prior to construction.	It is ***probable*** that a negative impact to kestrel **will not be significant**.

13.6 MONITORING

Water quality monitoring will take place during the construction phase of the Upperchurch Windfarm and for years 1 and 2 of operation. Monitoring of water quality parameters will be conducted monthly in Year 1. If thresholds are not exceeded in Year 1, then the effort may be reduced in Year 2. The scope of this monitoring will be developed in consultation with Inland Fisheries Ireland.

Routine inspection and maintenance of sediment and erosion control measures will take place regularly during the construction phase and during the operational life of the project.

- It is recommended the following post-construction Ornithological surveys are undertaken including the following elements:
  - Vantage point surveys
  - Transect surveys

The full scope and timing of these surveys will be in consultation with NPWS prior to the completion of the construction phase.

13.7 CONCLUSION

The main points of the ecological impact assessment are summarised below:

- The habitats identified within the proposed 22-turbine windfarm study area are the improved agricultural grassland (GA1), wet grassland (GS4), coniferous plantation (WD4), wet heath (HH3), upland blanket bog (PB2), acid grassland (GS3) upland/eroding streams (FW1), spoil and bare ground (ED2), buildings and artificial surfaces (BL3), neutral grassland (GS1), hedgerows (WL1), drainage ditches (FW4) and treelines (WL2).
- The proposed windfarm lies within 10 km of Lower River Shannon cSAC (site code 002165), Bolingbrook Hill cSAC (site code 002124), Lower River Suir cSAC (site code 002137), Anglesey Road cSAC (site code 002125), Slievefelim to Silvermines Mountains SPA (site code 004165), Mauherslieve Bog NHA (site code 002385), Bilboa and Gortnageragh River Valleys pNHA (site code 001851), Killavalla Wood pNHA (site code 001178), Nenegh River Gorge pNHA (site code 001133), Aughnaglanny Valley pNHA (site code 000948) and Inchinsquillib and Dowling's Woods pNHA (site code 000956). An Appropriate Assessment has been undertaken to determine the significance of the impact on Natura 2000 sites. No adverse impact is expected to arise to NHAs not covered by Natura 2000 sites.
- The main potential negative impacts identified relate to habitat loss, disturbance to fauna during construction phase of the development, risk of collision for the local bird and bat populations and the pollution of waterways downstream of the drains/streams within the proposed site.

- A comprehensive erosion and sediment plan has been developed and this will reduce the likelihood of any potential pollution event occurring which could impact on protected sites downstream of the development. Other mitigation measures include the implementation of a fuel management plan, control of wheel wash, dewatering and concrete, and the recommendation for the composition of an ecological management plan prior to construction.
- Pre-construction monitoring will be undertaken for birds and post construction monitoring will be undertaken for the first two year of operation.
- No significant ecological residual impacts are expected as a result of the construction and operational phase of the proposed Upperchurch Windfarm.

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FIGURE 13-1: SPECIAL AREAS OF CONSERVATION (SAC) WITHIN 10KM OF THE STUDY AREA

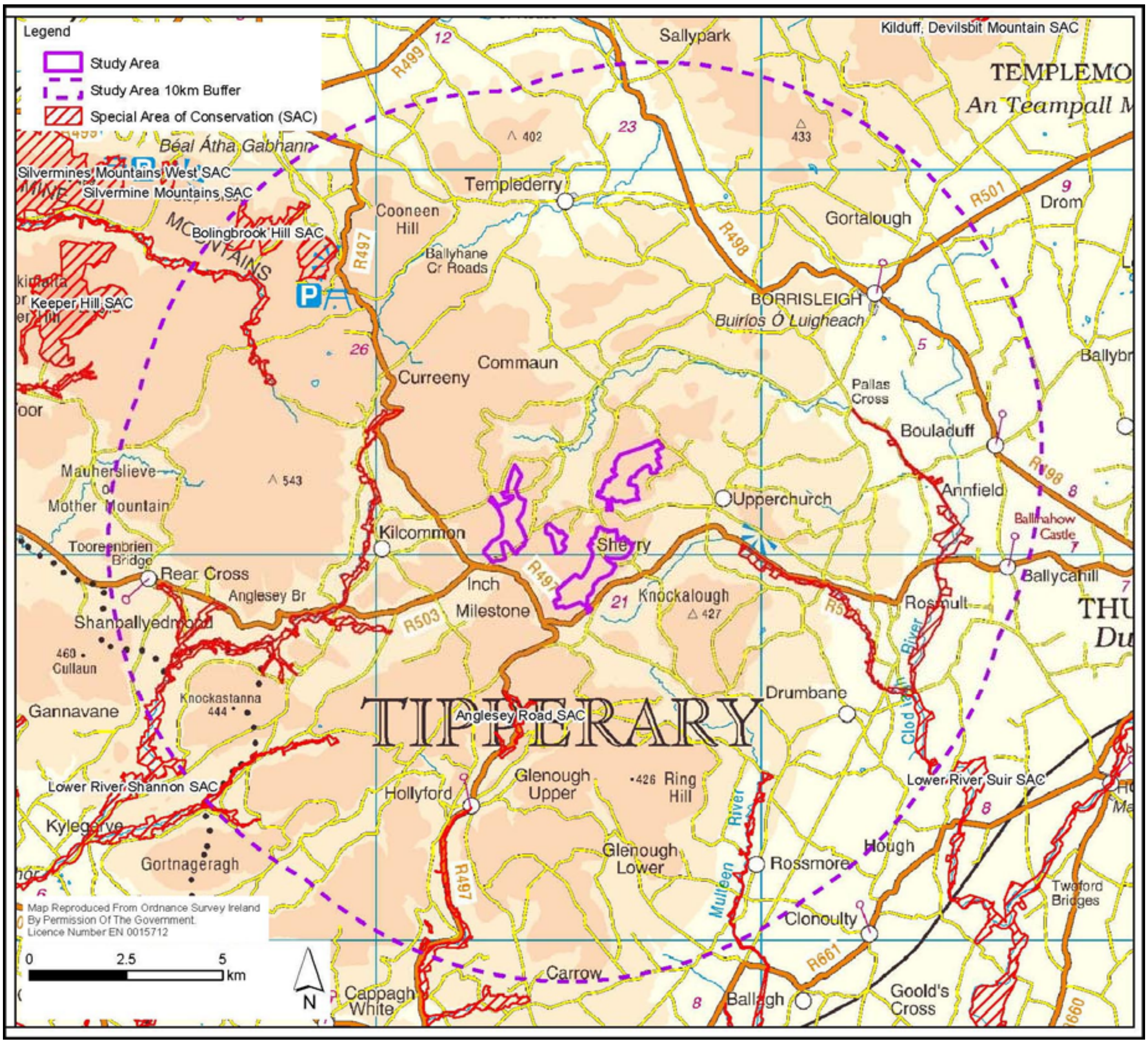

FIGURE 13-2: SPECIAL PROTECTION AREAS (SPA) WITHIN 10KM OF THE STUDY AREA

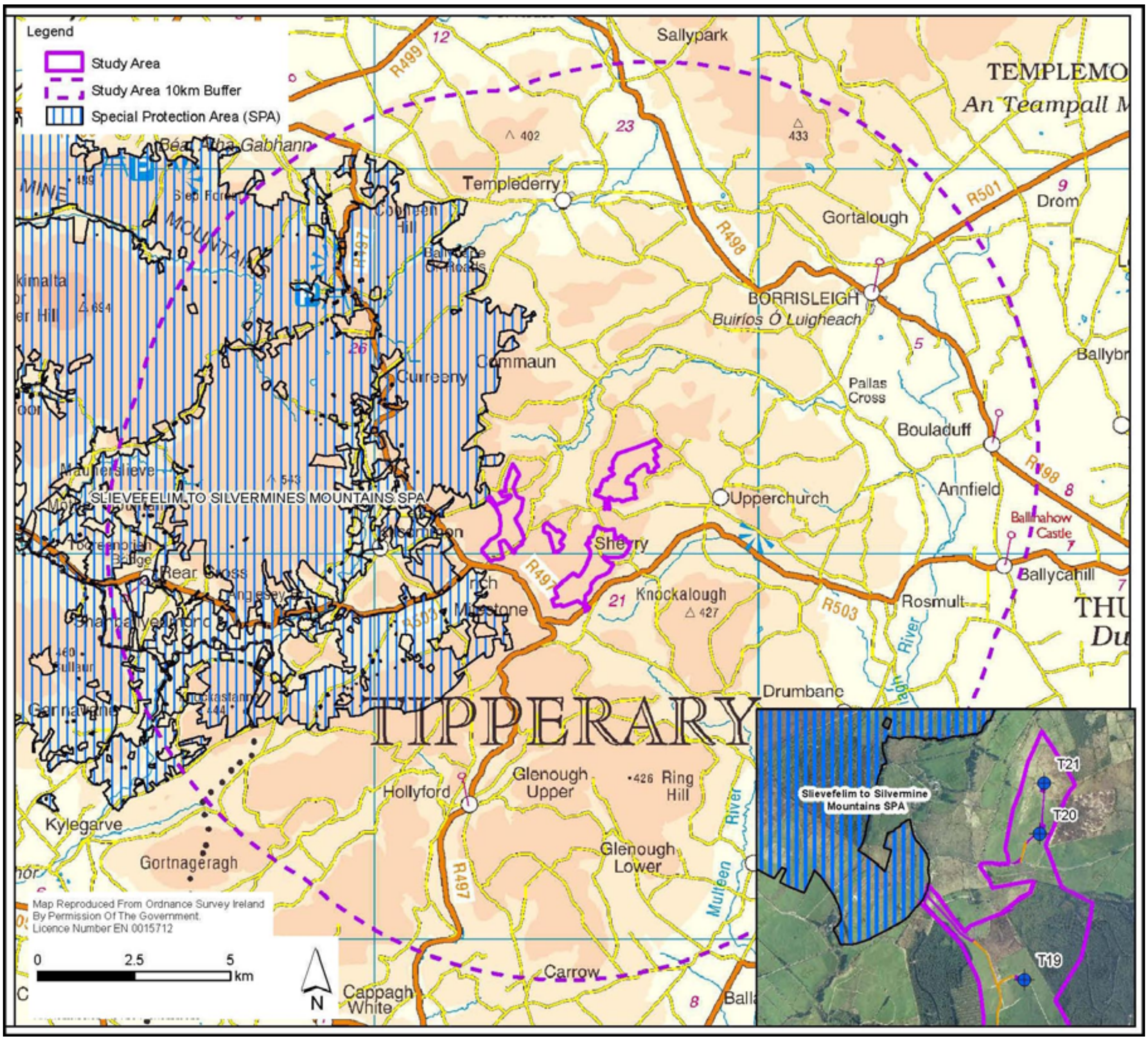

FIGURE 13-3: NHA AND PNHA WITHIN 10KM OF THE STUDY AREA

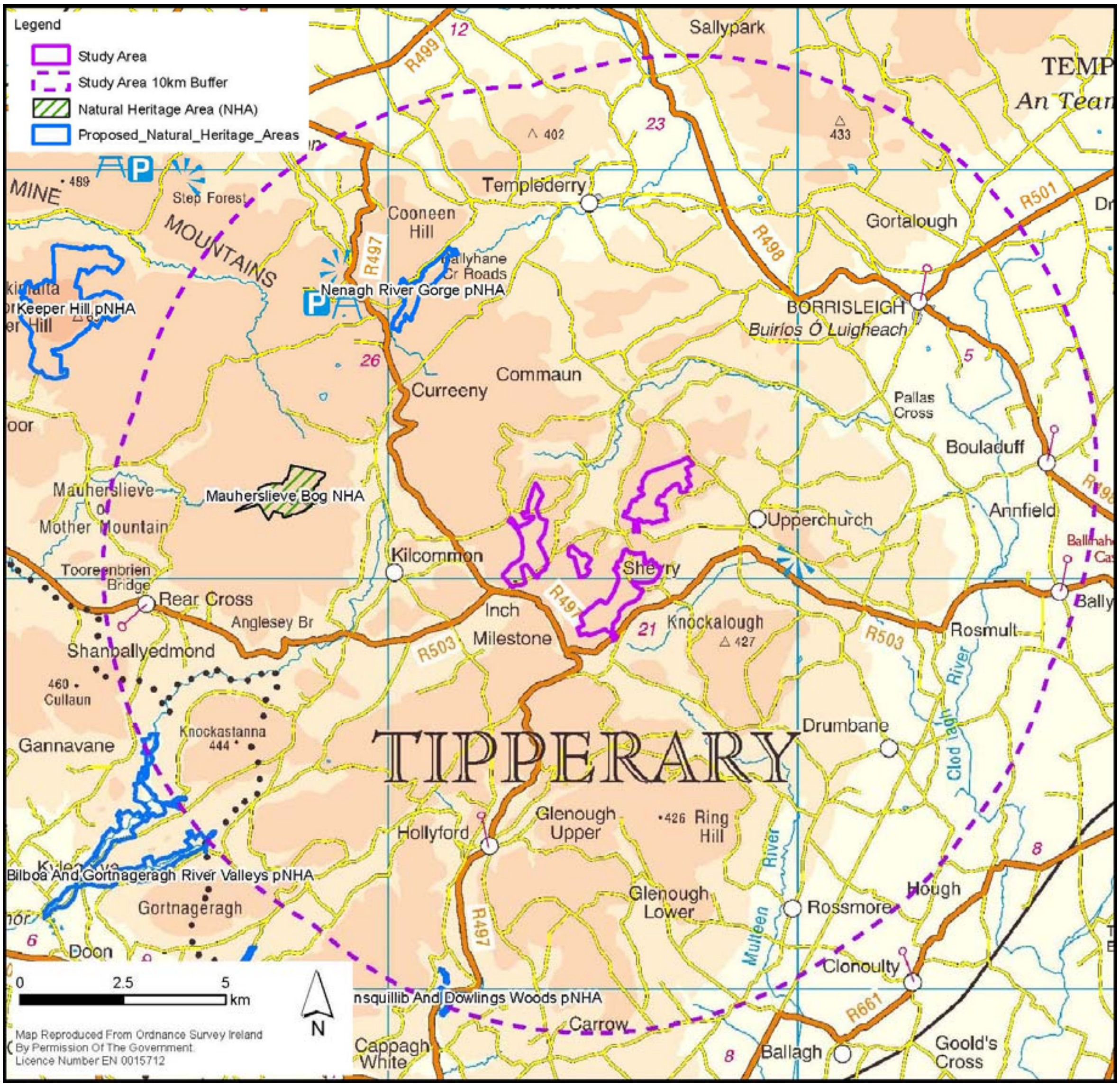

FIGURE 13-4: HABITAT MAP 1 OF 3

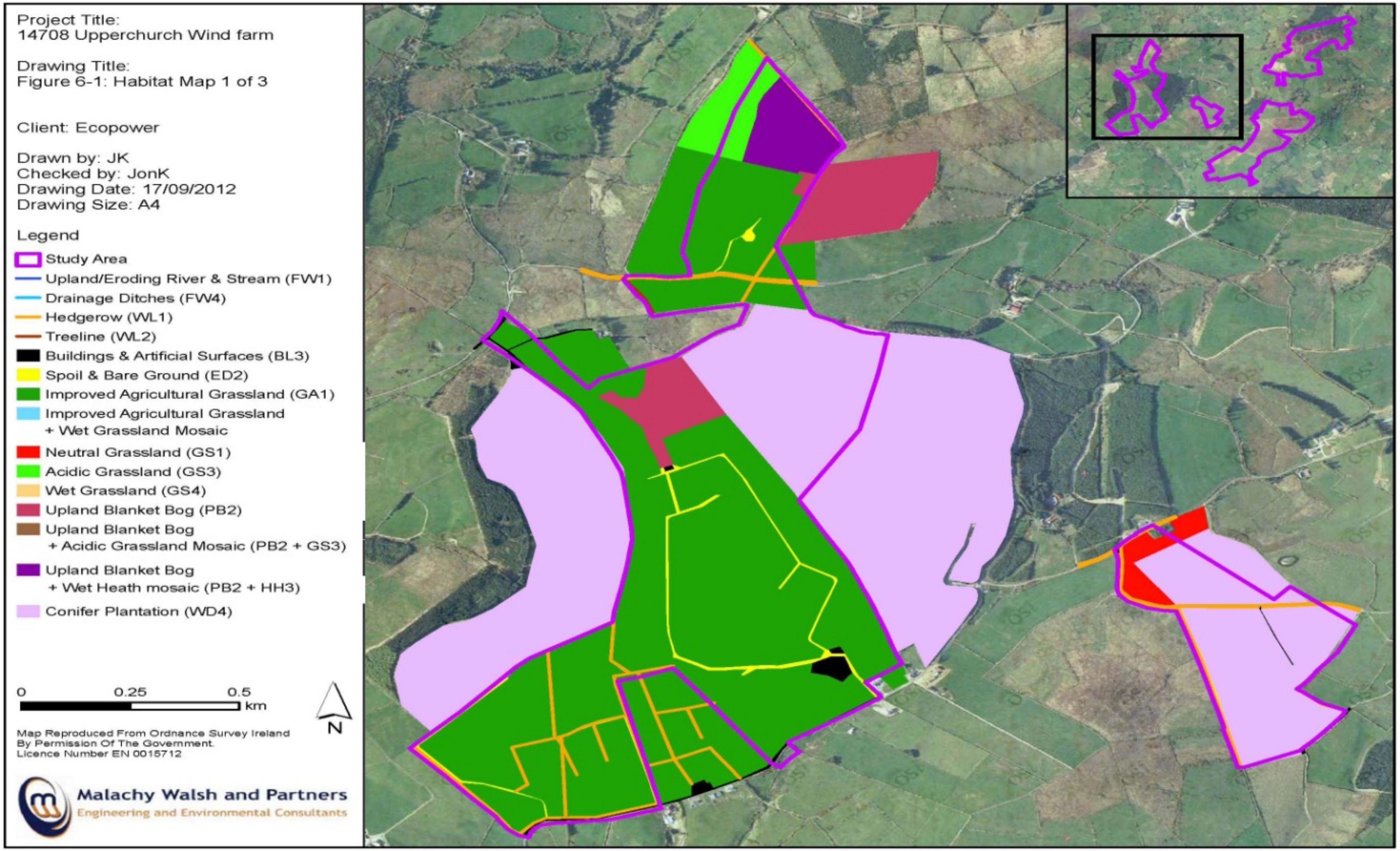

FIGURE 13-4: HABITAT MAP 2 OF 3

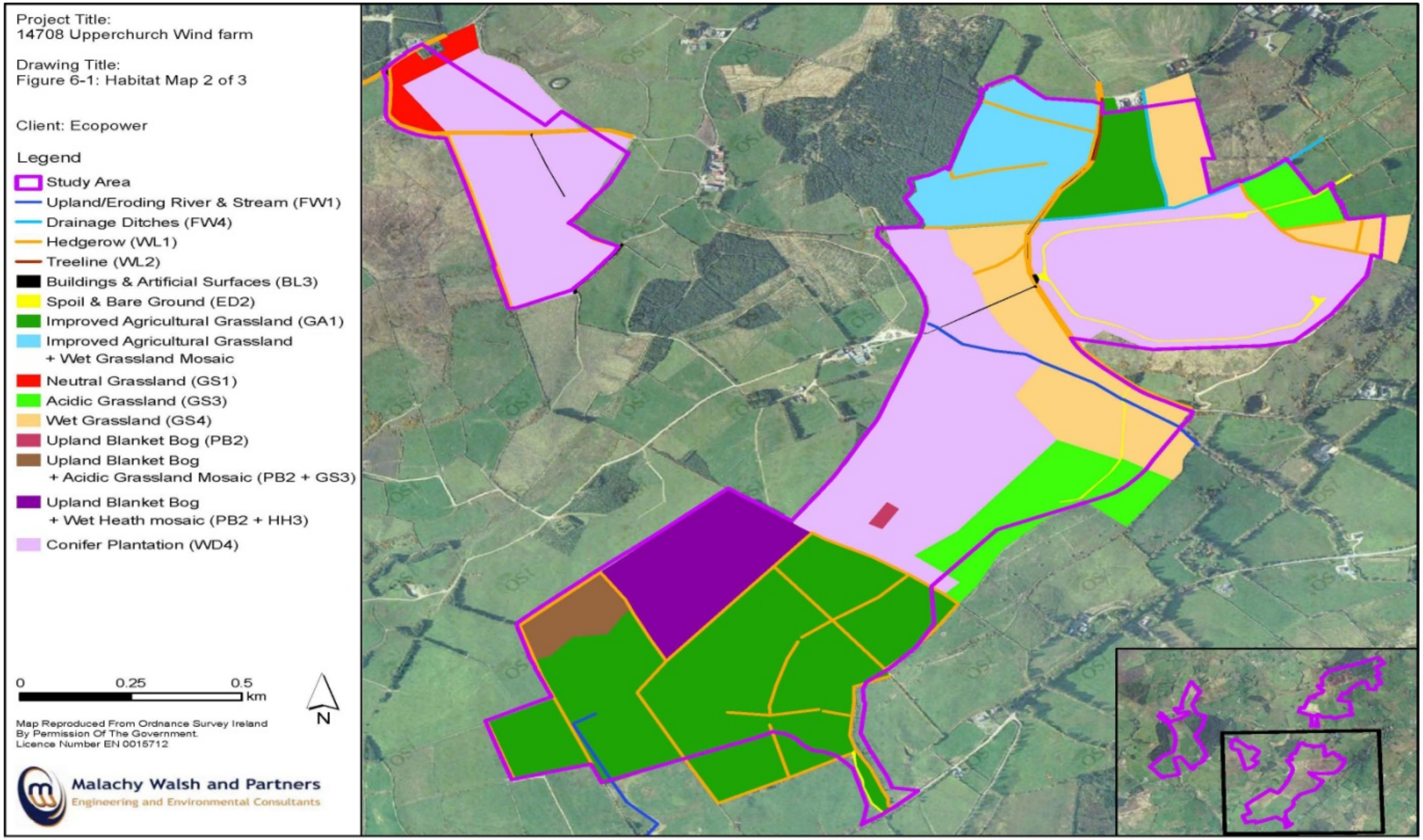

FIGURE 13-4: HABITAT MAP 3 OF 3

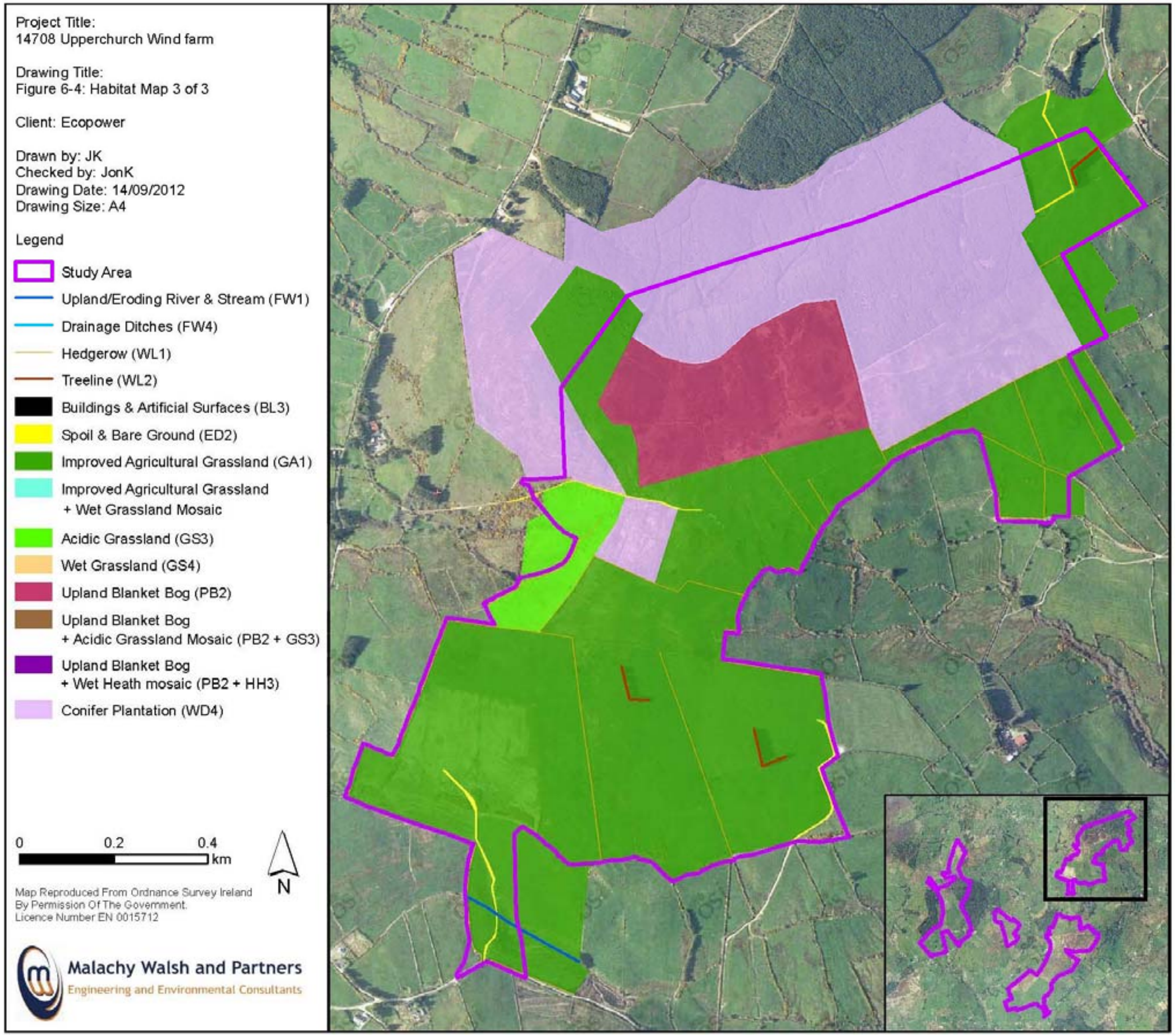

FIGURE 13-5: LOCATION OF SAMPLING STATIONS

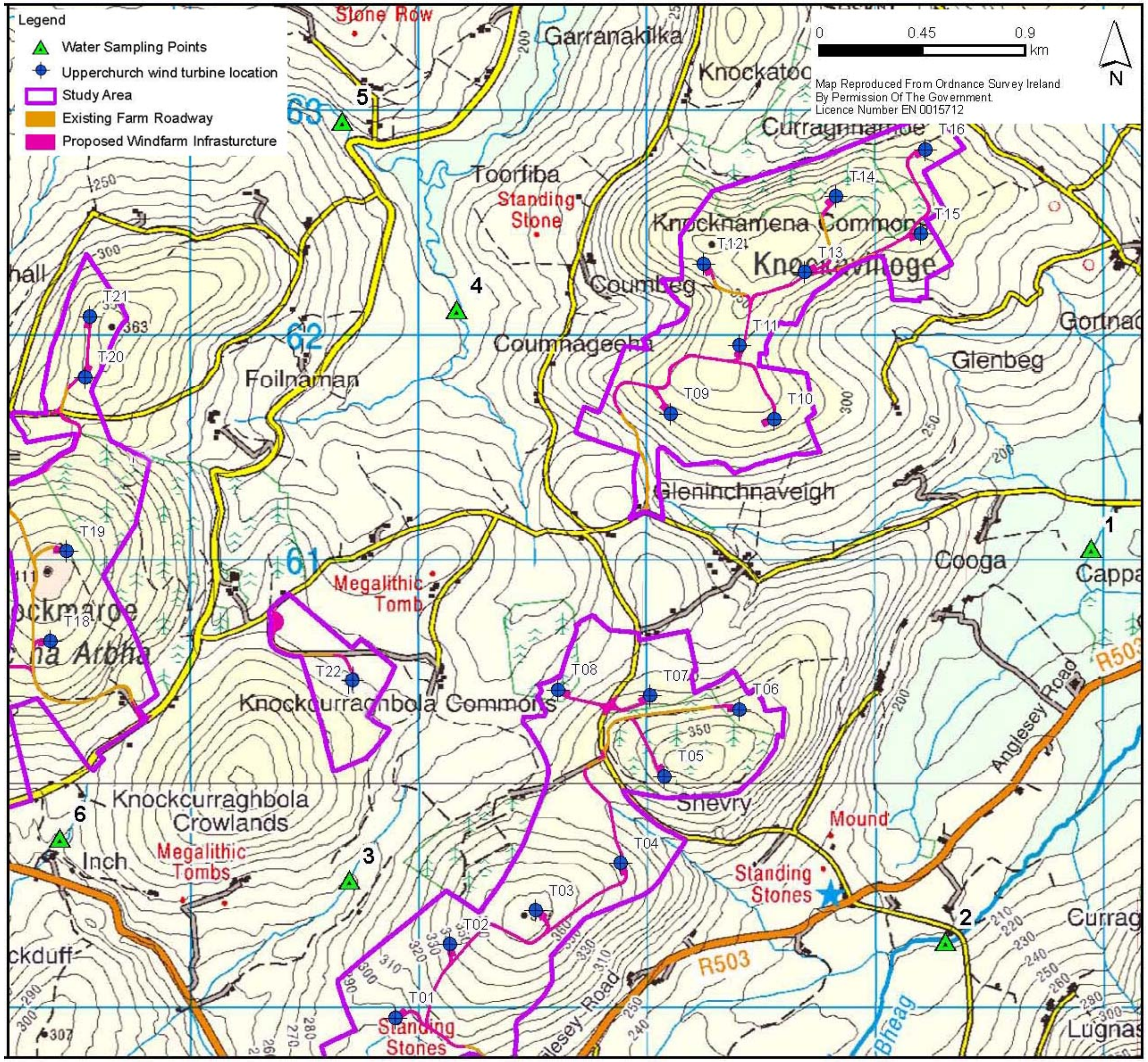

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FIGURE 13-6: BAT TRANSECT ROUTES

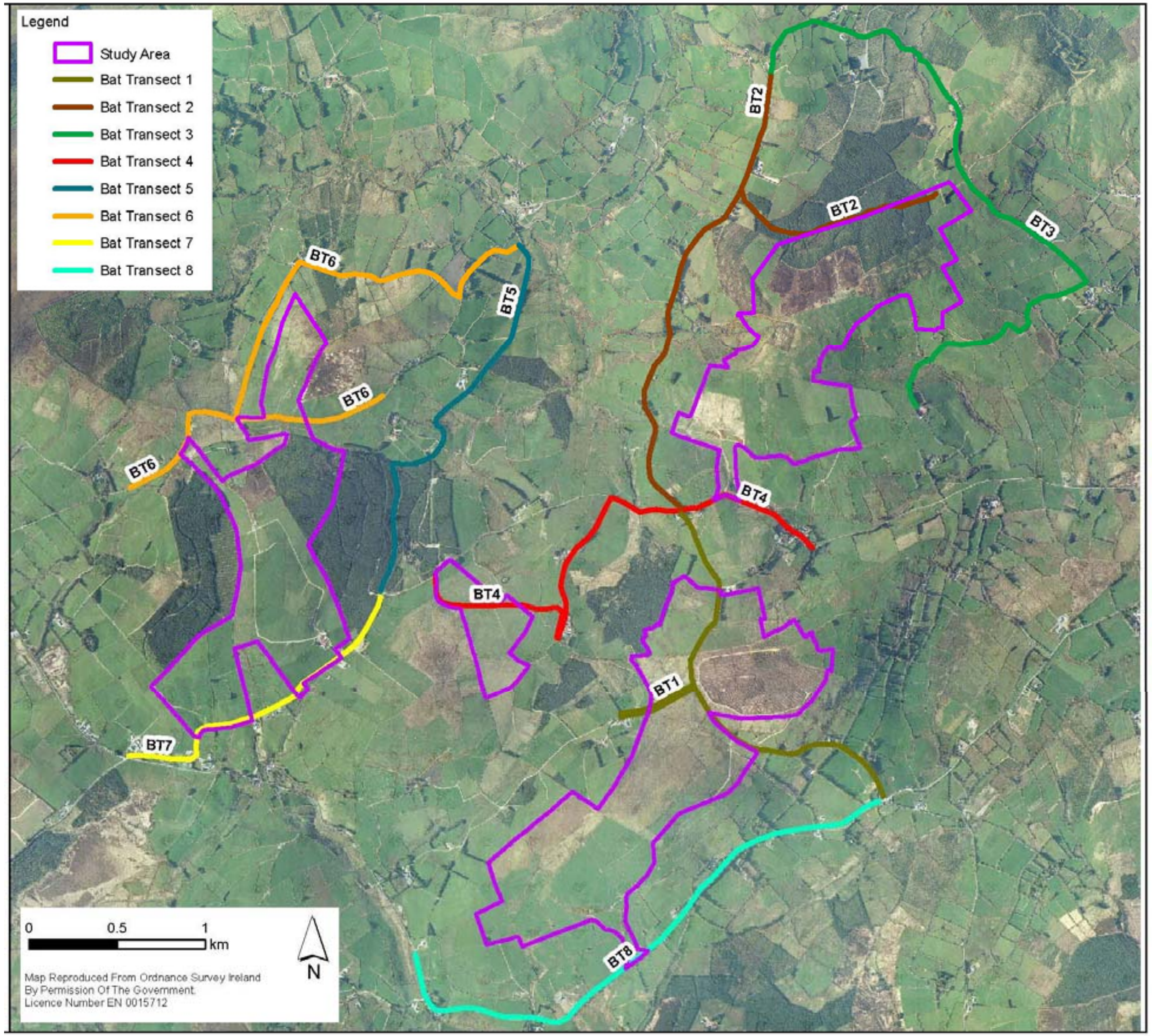


FIGURE 13-7: VANTAGE POINTS

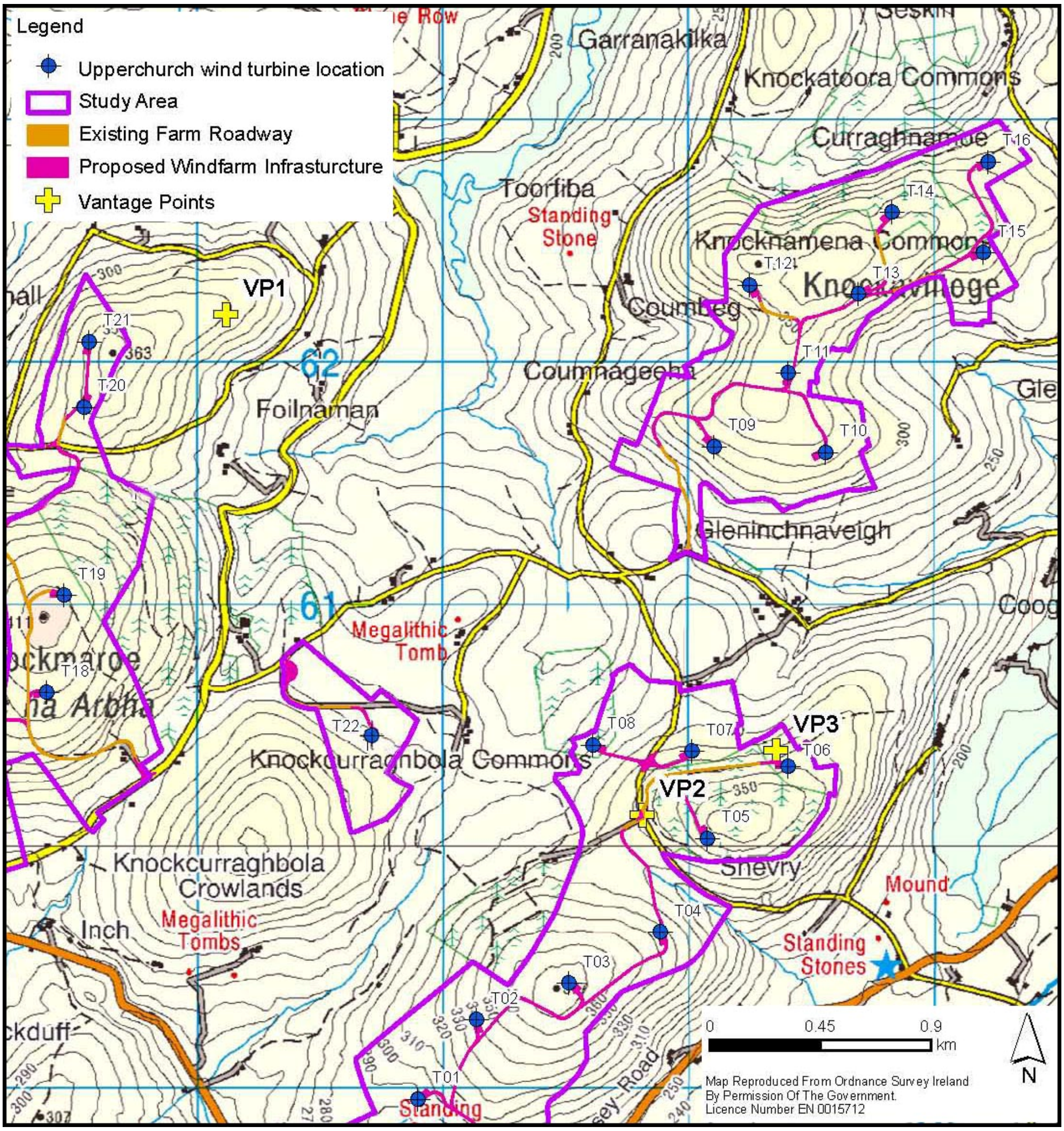
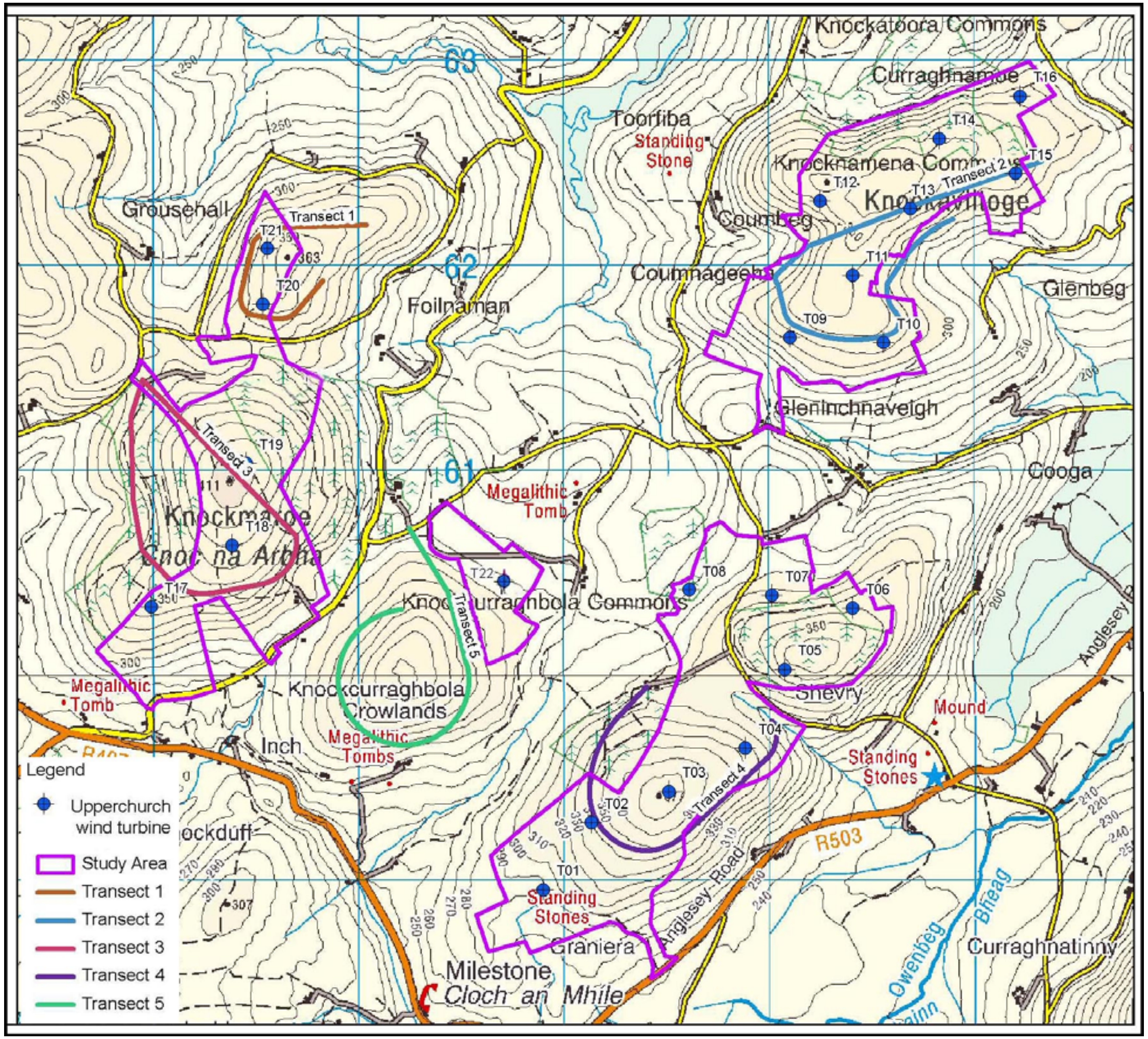


FIGURE 13-8: BIRD TRANSECT ROUTES



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REFERENCE DOCUMENTS

FIGURE 13-9: PERMITTED AND EXISTING WINDFARMS IN THE AREA

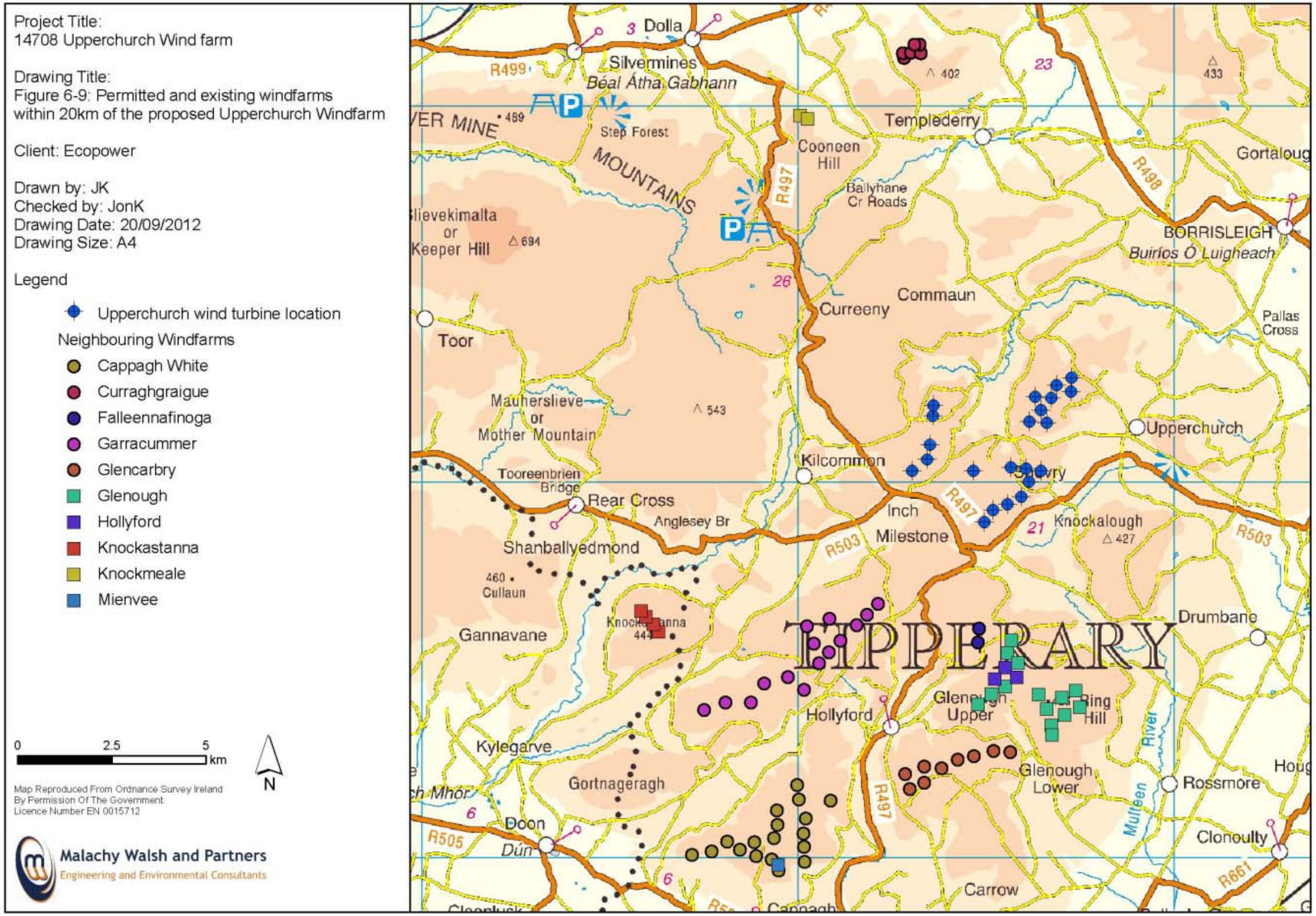

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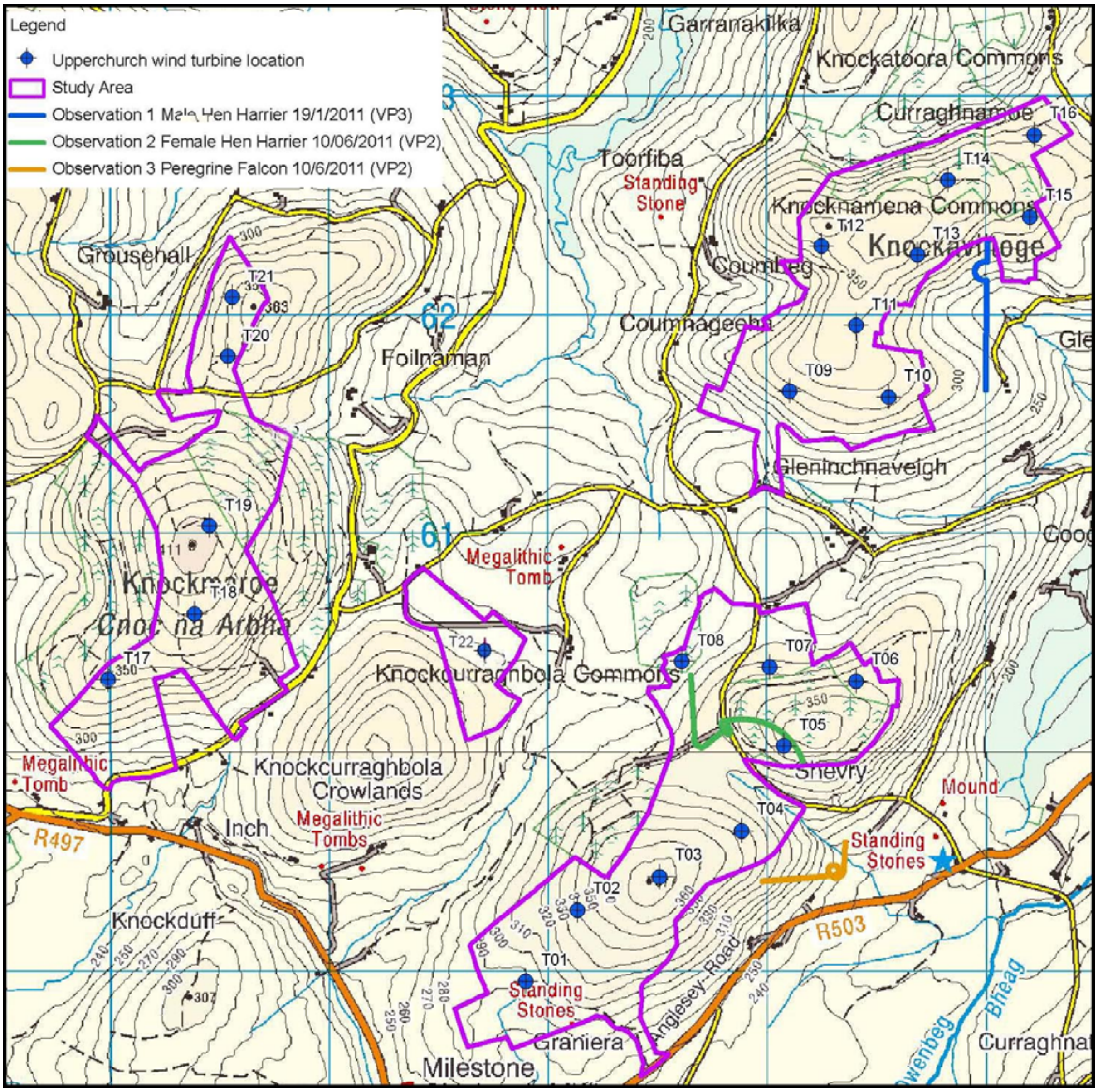
FIGURE 13-10: BIRD OBSERVATIONS



APPENDIX 13-I PHOTOGRAPHS

Plate 1: Improved agricultural grassland in the location of T 17 with conifer plantation running along the western boundary.

Plate 2: Typical hedgerow that is found in the western section of the site. With gorse being the dominant species.

Plate 3: Farm track that runs through the centre of the western section.

Plate 4: Farm track which does not have any imported material. This habitat is readily colonised by plants with little disturbance.

Plate 5: At the location of T 19. Dairy farming has influenced the the area greatly.

Plate 6: Improved agricultural grassland adjacent to upland blanket bog located to the west of T 22.

Plate 7: Acidic grassland occurring to the north west of T 21.

Plate 8: Field to the east of T 8 with wet grassland and improved agricultural grassland on higher ground.

Plate 9. Wet grassland to east of T 8. Rushes were abundant. Other species included creeping buttercup and cuckoo flower.

Plate 10: Drainage ditch to the east of T 7 draining to the north.

Plate 11. Drainage ditch draining from east to west, which had very little water during time of survey. Located to the west of T 7.

Plate 12: Spruce conifer plantation to the west of T 7 and acidic grassland to the south/south west.

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Plate 13: Common mouse with water filled depression in background. Located to east of T 7.

Plate 14: Neutral grassland located in the central section to the south of T 23.

Plate 15: Roadway which runs through the central section

Plate 16: Cuckoo flower found in wetter areas throughout the site.

Plate 17: Lousewort, present on wet heath and upland blanket bog.

Plate 18: Tormentil, Present on many habitats within site. Sign of acidic conditions.

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APPENDIX 13-II
NATURA IMPACT STATEMENT

UPPERCHURCH WINDFARM

14708

September 2012

Job number	Revision	Prepared by	Checked by	Status	Date
14708 - 6005	Rev A	CON	JK	Draft	17th September 2012

1 Introduction

1.1 BACKGROUND

Member States are required to designate Special Areas of Conservation (SACs) and Special Protected Areas (SPAs) under the EU Habitats and Birds Directives, respectively. SACs and SPAs are collectively known as Natura 2000 sites. An 'Appropriate Assessment' (AA) is a required assessment to determine the likelihood of significant impacts, based on best scientific knowledge, of any plans or projects on Natura 2000 sites. A screening for AA determines whether a plan or project, either alone or in combination with other plans and projects, is likely to have significant effects on a Natura 2000 site in view of its conservation objectives.

This AA screening has been undertaken to determine the potential for significant impacts of a proposal to construct a 22 turbine windfarm, 1.9 km west of Upperchurch and a further 18 km west of Thurles in county Tipperary, on nearby Sites with European conservation designations (i.e. Natura 2000 Sites). The purpose of this assessment is to determine, the appropriateness, or otherwise, of the proposed project in the context of the conservation objectives of such sites. For clarity of nomenclature this proposal will be described, hereinafter, as the Upperchurch Windfarm.

This Screening for Appropriate Assessment has been undertaken by Malachy Walsh and Partners ecologists.

Assessment of potential impacts on other species of national and community interest does not fall within the scope of this report.

An Environmental Impact Statement has also been carried out in association with the proposed windfarm.

1.2 LEGISLATIVE CONTEXT

The Habitats Directive (92/43/EEC) seeks to conserve natural habitats and of wild fauna and flora by the designation of SACs and the Birds Directive (79/409/EEC) seeks to protect birds of special importance by the designation of SPAs. It is the responsibility of each member state to designate SPAs and cSACs, both of which will form part of Natura 2000, a network of protected sites throughout the European Community.

An Appropriate Assessment is required under Article 6 of the Habitats Directive where a project or plan may give rise to significant effects upon a Natura 2000 Site, and paragraphs 3 and 4 state that:

6(3) *Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with* *other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives. In the light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public.*

6(4) *If, in spite of a negative assessment of the implications for the site and in the absence of alternative solutions, a plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature, the Member State shall take all compensatory measures necessary to ensure that the overall coherence of Natura 2000 is protected. It shall inform the Commission of the compensatory measures adopted. Where the site concerned hosts a priority natural habitat type and/or a priority species, the only considerations which may be raised are those relating to human health or public safety, to beneficial consequences of primary importance for the environment or, further to an opinion from the Commission, to other imperative reasons of overriding public interest.*

The current assessment was conducted within this legislative framework and also the recent DoEHLG (2009) guidelines. As outlined in these, it is the responsibility of the proponent of the project developer to provide a comprehensive and objective Screening for Appropriate Assessment, which can then be used by the competent authority in order to conduct the Appropriate Assessment (DoEHLG, 2009).

1.3 STAGES OF AA

A Screening for Appropriate Assessment (AA) has been prepared by Malachy Walsh and Partners, to determine the likelihood of significant impacts, if any, of the proposal to construct a 22 turbine windfarm and all associated works located 1.9km west of Upperchurch village and a further 18km west of Thurles in County Tipperary, on nearby sites with European conservation designations (i.e. Natura 2000 sites). A Natura Impact Statement (NIS) has also been undertaken and is presented in this report after the screening stage.

The AA process is a four-stage process to complete the AA, with issues and tests at each stage. An important aspect of the process is that the outcome at each successive stage determines whether a further stage in the process is required. This proposal has proceeded as far as Stage 2 only.

The first stage of the AA process and that undertaken to determine the likelihood of significant impacts of this proposal is:

- Stage 1: *Screening.*

The second stage of the AA process assesses the impact of the proposal (either alone or in combination with other projects or plans) on the integrity of the Natura 2000 site with respect to the conservation objectives of the site and its ecological structure and function. A Natura Impact Statement was prepared for this proposed development. A Natura Impact Statement containing a professional scientific examination of the proposal is required and includes any mitigation measure to avoid, reduce or offset negative impacts:

- Stage 2: *Natura Impact Statement (NIS).*

If the outcome of Stage 2 is negative i.e. adverse impacts to the sites cannot be scientifically ruled out, despite mitigation, the plan or project should proceed to Stage 3 or be abandoned. This stage examines alternative solutions to the proposal:

- Stage 3: *Assessment of alternative solutions.*

The final stage is the main derogation process examining whether there are imperative reasons of overriding public interest (IROPI) for allowing a plan or project to adversely affect a Natura 2000 site where no less damaging solution exists:

- Stage 4: *Assessment where no alternative solutions exist and where adverse impacts remain.*

In summary, the purpose of the Screening stage is to determine the necessity or otherwise for a NIS. Screening for AA examines the likely effects of a project or plan, alone and in combination with other projects or plans, upon a Natura 2000 site and considers whether it can be objectively concluded that these effects will not be significant. If it is determined during screening that the proposal may have a significant effect on a Natura 2000 site then a NIS will need to be prepared. A Screening exercise has been undertaken and concluded that a NIS was required. The Screening is outlined in section 2 below as it now forms part of the overall NIS. The NIS is presented in Section 3 below.

1.4 SCREENING STEPS

This Screening for AA, or Stage 1 of AA, has been undertaken in accordance with the European Commission Methodological Guidance on the provision of Article 6(3) and 6(4) of the 'Habitats' Directive 92/43/EEC (EC, 2001) and the European Commission Guidance 'Managing Natura 2000 sites' (EC, 2000).

Screening for AA involves the following:

- Establish whether the plan is necessary for the management of a Natura 2000 site;
- Description of the Plan;
- Identification of Natura 2000 sites potentially affected;

- Identification and description of individual and cumulative impacts likely to result from the plan;
- Assessment of the significance of the impacts identified above on site integrity; and
- Exclusion of sites where it can be objectively concluded that there will be no significant effects.

Stage 1, Screening, examines whether or not likely effects upon a Natura 2000 site will be significant and determines whether the AA process for the proposed windfarm needs to proceed to Stage 2.

1.5 ASSESSMENT METHODOLOGIES

1.5.1 In house Consultation with Design Engineers

Consultation with the client, Ecopower Developments, and with Malachy Walsh and Partners' in-house engineering team was conducted on an ongoing basis in order to formulate a project design which would avoid, by design and at source, any construction activities that could initiate potential water quality impacts. As a consequence, all aspects of the construction of the proposed windfarm and its layout adopted an avoidance by design approach. An example of this aspect of the avoidance by design approach is the fact that the windfarm roads and the turbine sites for the most part were located on the least ecologically sensitive areas found during the site investigation in order to minimise potential impacts. In addition, it was decided to remove if possible, from the projects design, all elements that could impinge on the conservation interests of the nearby Lower River Suir cSAC and the Lower River Shannon cSAC located downstream thereby avoiding impacts at source.

1.5.2 Desk Study

A desk study was carried out to collate available information on the proposal site's natural environment. This comprised a review of the following publications and datasets:

- OSI Aerial photography and 1:50000 mapping;
- National Parks and Wildlife Service (NPWS);
- BirdWatch Ireland;
- Teagasc soil area maps (NBDC website);
- Geological Survey Ireland (GSI) area maps;
- Environmental Protection Agency (EPA) water quality data;
- Shannon River Basin District (ShRBD) datasets (Water Framework Directive);
- South Eastern River Basin District (SERBD) datasets (Water Framework Directive); and
- National Biodiversity Centre (NBDC) (on-line map-viewer).

1.5.3 Ecological Site Surveys

1.5.3.1 Habitat surveying, mapping and evaluation

Field surveys were conducted by ecologists during the month of June 2012. Habitats were categorised according to the Heritage Council's '*A Guide to Habitats in Ireland'* (Fossitt, 2000) to level 3.

The habitat mapping exercise had regard to the 'Best Practice Guidance for Habitat Survey and Mapping' (Smith *et al.* 2011) published by the Heritage Council. Laminated A3 aerial photography was used together with a GPS to accurately enable field navigation. Habitat categories, characteristic plant species and other ecological features and resources were recorded on waterproof field sheets.

Scientific and common names for plants follow Parnell *et al*. (2012) and Blamey *et al*. (1996), respectively. Habitat boundaries and associated attribute data were mapped using desk-based GIS software, namely ArcView 9.2.

1.5.3.2 Water quality and aquatic habitat assessment

In order to to collect baseline water quality data and in order to conduct fisheries and riparian habitat evaluations, a programme of biological and physico-chemical water quality assessments were undertaken in the waterways draining the area of the proposed windfarm. Streams in the vicinity of the proposed development were surveyed by an ecologist on the 11^{th} of June and 22^{nd} of August, 2012. A total of six sampling points were strategically identified at locations within the catchment areas of the proposed Upperchurch Windfarm site in order to assess and give an indication on the water quality in the immediate area surrounding the proposed windfarm site.

Biological water quality monitoring refers to Q Value system of ranges where the relationship between water quality and the in-stream macroinvertebrate community is described in numerical terms. A Q value of 5 indicates very high water quality while a Q value of 1 indicates poor water quality. Kick sampling, where the river bed is disturbed using the foot immediately upstream of a kick net, which collects the sample, was conducted at five sampling stations just downstream of the study area. Macroinvertebrate samples were returned to the laboratory where species within each kick sample were identified to genus level. Differing macroinvertebrate species are assigned to a group according to its tolerance of or sensitivity to water pollution. A river is then assigned a Q value based on these groupings. Table 1, below indicates the relationship between Q values and water quality.

TABLE 1: RELATIONSHIP BETWEEN BIOTIC INDEX (Q-VALUE) AND WATER QUALITY.

Biotic Index	EPA Water Quality	Water Framework Directive Ecological Status	Quality Status
Q5	Good	High	Unpolluted Waters
Q4-5	Fair - Good	High	
Q4	Fair	Good	
Q3-4	Doubtful - Fair	Moderate	Slightly Polluted Waters
Q3	Doubtful	Poor	Moderately Polluted Waters
Q2-3	Poor - Doubtful	Poor	
Q2	Poor	Bad	Seriously Polluted Waters
Q1-2	Bad - Poor	Bad	
Q1	Bad	Bad	

1.5.3.1 Ornithological surveys

Winter Hen Harrier Survey 2010/2011

Field surveys were undertaken at the proposed site in order to examine the usage and activity of hen harriers at the site during the winter of 2010/2011.

Vantage Point Observations

Vantage point observations were carried out in order to assess the level of raptor activity and purpose at the development site. These observations were carried out in accordance with NPWS hen harrier survey guidelines. Three (3) vantage point locations were selected in order to obtain maximum visibility of the site and habitats outside the site boundary.

Vantage point watches were of six (6) hours duration and the three vantage points were watched for a total of eighteen (18) hours per site visit. During the course of the survey from November 2010 to March 2011 the site was watched for a total of ninety (90) hours. The locations of the vantage points are illustrated in **Figure 13-7** at the end of Chapter 13.

Summer Hen Harrier Survey 2011

Vantage Point Observations

Vantage point observations were carried out in order to assess the level of raptor activity and purpose at the development site during the summer of 2011. These observations were carried out in accordance with NPWS hen harrier survey guidelines. The vantage point locations chosen for the summer hen harrier survey remained the same as those chosen for the winter hen harrier survey.

Vantage point watches were of six (6) hours duration and the three vantage points were watched for a total of eighteen (18) hours per site visit. During the course of the summer survey from April to July 2011 the site was watched for a total of seventy two (72) hours. The locations of the vantage points are illustrated in **Figure 13-7** at the end Chapter 13.

Transect surveys

Winter Transect counts were undertaken on 19th January and 16th March 2011 at five locations across the site and their locations are illustrated in **Figure 13-8** at the end of Chapter13. Transect counts were undertaken on 19th May and 12th July 2011 at the same five locations as the winter bird survey.

1.5.3.2 Otter survey

A survey for signs of otters, including scat and evidence of otter holts, was carried out in conjunction with the programme of water quality assessments described above and during the ecological site visits.

1.5.4 Assessment of Potential Impact Significance

Once the potential impacts that may arise from the proposal are identified the significance of these is assessed through the use of key indicators:

- Habitat loss;
- Habitat alteration;
- Habitat or species fragmentation;
- Disturbance and/or displacement of species; and
- Water quality and resource.

In line with the EPA Guidelines (EPA, 2002), the following terms are defined when quantifying duration:

- Temporary: up to 1 year;
- Short-term: from 1-7 years;
- Medium-term: 7-15 years;
- Long-term: 15-60 years; and
- Permanent: over 60 years.

The criterion for confidence levels of the predicted likely impacts are given here in Table 1 as recommended by IEEM, (2006) and NRA, (2009).

TABLE 2: CONFIDENCE LEVELS OF PREDICTIONS OF LIKELY IMPACTS AS OUTLINED IN NRA (2009) AND IEEM (2006).

Confidence level category	
Near certain	>95% chance of occurring as predicted
Probably	50-95% chance of occurring as predicted
Unlikely	5-50% chance of occurring as predicted
Extremely unlikely	<5% chance of occurring as predicted

The impact significance criteria follow EPA guidance (EPA, 2002).

TABLE 3: SIGNIFICANCE OF IMPACT (EPA, 2002).

Significance of Impacts	**Definition**
Imperceptible Impact	An impact capable of measurement but without noticeable consequences.
Slight Impact	An impact which causes noticeable changes in the character of the environment without affecting its sensitivities.
Moderate Impact	An impact that alters the character of the environment in a manner that is consistent with existing and emerging trends.
Significant Impact	An impact which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
Profound Impact	An impact which obliterates sensitive characteristics.

2 Stage 1 Screening

2.1 MANAGEMENT OF NATURA 2000 SITE

The proposal is not connected with or necessary to the conservation management of a Natura 2000 site.

2.2 DESCRIPTION OF PROJECT

2.2.1 Brief Project Description

It is proposed to construct the 22 turbine windfarm at a location situated approximately 1.9 km west of the village of Upperchurch and a further 18 km west of Thurles in County Tipperary. The turbines are numbered T01 to T22 and are arranged in four clusters as follows:

- T01 to T08 are arranged around two hills at Shevry;
- T09 to T16 are arranged around the hill at Knocknamena;
- T17 to T21 are arranged around two hills at Knockmaroe and Foilnaman; and
- T22 is a single turbine on the northeast side of the hill at Knockcurraghbola.

The individual clusters occur within a series of small hills or drumlins and are distributed over an area of $12km^2$. The hills are at elevations of between 363mOD and 411mOD and the peaks are generally at heights of 100m above the intervening lower terrain. The highest peak is that of Knockmaroe at an elevation of 411mOD (Grid Ref: R193372 160945). All of the proposed wind turbine locations are on elevated sloping ground with good natural drainage to the streams in the surrounding valley.

2.2.2 Purpose of the Project Proposal

The purpose of the project is to generate electricity from wind energy and to export to the national grid. It will produce pollution free electricity with the capacity to provide power, generating 150 million kWh, for up to 23,070 homes.

2.2.3 Description of the Site

The principal land uses within the greater area are pasture (dairy farming and dry cattle) and some blocks of conifer plantation occur within the site. The surrounding local landscape is a mixture of predominantly improved agricultural grassland, acidic grassland, upland blanket bog with some of this habitat forming mosaics with wet heath.

An ecological survey, conducted as part of the EIS associated with the proposed windfarm, determined that the habitats listed at Table 4, below, comprise the habitats in the area of the proposed windfarm.

It was clear from the ecological survey that the extent of upland blanket bog habitat within the site boundary and the greater geographical area was larger historically. Both the quality and extent of this habitat has been significantly reduced by peat-cutting and agricultural land management practises including drainage, grazing, fertilisation and reseeding. There is evidence of peat harvesting in the past with small areas of this habitat occurring within limited sections of the site where peat banks of up to 1.3 m can be seen.

The soil composition within the turbine cluster areas is, variously comprised of mosaics of 'Surface water Gleys / Ground water Gleys acidic' ,'Lithosols / Regosols', 'Podzols Peaty', 'Shallow Peaty Gleys' and 'Acid Brown Earths/ Brown Podzolics'. Bedrock at the location is 'Silurian Metasediments and Volcanics' with some rock outcropping, most notably at the northeast part of the site.. The Corine Landcover classes 'Pasture', 'Bog', 'Other' and 'Forestry' are the dominant types in the area around the windfarm and in the greater geographical area extending away from the proposal site[1].

Three first order streams situated adjacent to the proposed windfarm site drain into streams that form the upper reaches of the Turraheen, Owenbeg, Clodiagh and Aughvana Rivers. The first three of these rivers form part of the South Eastern River Basin District and ultimately join the River Suir to the southeast. The Aughvana River, which forms part of the Shannon River Basin District, joins the Mulkear River and ultimately flows into the River Shannon to the east of Limerick City.

The site drains to the different rivers as follows:

Suir Catchment

- The area around turbines T01 and T02 drains towards the west to an unnamed tributary of the Turraheen River.
- The area around turbines T03, T04, T05 and T06 drains to the southeast to the Owenbeg River and its tributaries.
- The area around turbines T07, T08 and T09 drains to the north to the streams that form the upper reaches of the Clodiagh River.
- The area around turbines T10, T11, T13 and T15 drains to the south and southeast to tributaries of the Owenbeg River.
- The area around turbines T12, T14 and T16 drain to the west and north to the Clodiagh River.
- The areas around turbines T19, T20, T21 and T22 drain in different directions to unnamed tributaries of the Clodiagh River to the north.

[1] Data in this paragraph from http://maps.biodiversityireland.ie/#/Map [accessed 06/09/2012]

Shannon Catchment

- The area around turbines T17 and T18 drains south to an unnamed tributary of the Aughvana River. This is the only part of the overall site that forms part of the Shannon River Basin District.

2.2.4 Ecological description of the proposed Upperchurch Windfarm Site

2.2.4.1 Terrestrial Ecology

Habitat surveys were conducted by ecologists during the month of June 2012. Habitats were categorised according to the Heritage Council's 'A Guide to Habitats in Ireland' (Fossitt, 2000) to level 3. A total of 13 habitats types were identified within the proposed Upperchurch Windfarm EIS study area. The predominant habitats within the site are improved agricultural grassland and conifer plantation.

See **Figure 13-4 Map 1, Map 2** and **Map 3** at the end of Chapter 13 for habitat maps of the proposed Upperchurch Windfarm site. Site photographs of habitats are presented in **Appendix13-I**.

Table 4, below, lists the habitats recorded during the habitat survey with a qualitative description.

TABLE 4 SUMMARY LIST OF HABITATS RECORDED WITH SPATIAL DESCRIPTION

Habitat (code)	Evaluation
Improved Agricultural Grassland (GA1)	There is an extensive cover of Improved Agricultural Grassland throughout the site. The habitat is not species rich (as per agricultural grassland) but is of value to species which forage within it.
Coniferous Plantation (WD4)	There are 5 stands of conifer plantation within the study area planted on heath/upland blanket bog habitat. The dense growth within this habitat means there is very little light penetration reducing the diversity of plant species at ground level. Some areas have been felled and replanted. The younger stands have much more diverse vegetation undergrowth.
Wet Grassland (GS4)	This habitat is common in the lower lying areas and along margins of streams of the site. The wet grassland habitat has been modified by the building of drains around the field boundaries, reseeding and the application of fertiliser. While generally species poor the habitat is considered to be of some ecological value.
Wet Heath (HH3)	An area to the west of T2 in the south eastern section is classified as wet heath. This area was dominated by bell heather and purple moor-grass. This area would be subject to cattle grazing. Peat depth is low, approximately 0.3m. Formed due to peat extraction.
Acid Grassland (GS3)	This habitat occurs mainly outside of the enclosed grassland farm areas in areas where no reclamation has taken place but is extensively grazed by cattle. This habitat occurs to the south east of turbines T3 and T4 and on steep slopes to the northwest of turbine T21.
Upland Blanket Bog (PB2)	Upland blanket bog is one of the least dominant habitats within the study area. The habitat has been degraded by previous peat extraction, land reclamation, conifer plantation, grazing and drainage.
Eroding/Upland River (FW1)	There are 3 small, first order streams within the study area. These streams are quite small. Extensive man made drainage features drain into these

Habitat (code)	Evaluation
	habitats to dry out the surrounding low lying landscape.
Hedgerow (WL1)	There is a network of hedgerows along the improved grassland field boundary throughout the site.
Drainage Ditches (FW4)	Man-made features extending around the boundaries of lower lying agricultural fields and conifer plantation within the study area. Many are large with some vegetation.
Spoil and Bare Ground (ED2)	The forestry and farm roads within the site fall into this habitat category and are dominated by compact gravel which is naturally occurring to the area
Buildings and Artificial Surfaces (BL3)	Habitat of very low ecological value.
Treelines (WL2)	There are some small sections of treelines within the study area which mostly occur along tree-lined roads.
Neutral Grassland (GS1)	One section of this habitat near turbine T22.

2.2.4.2 Aquatic Ecology

A water quality assessment was undertaken of the waterways draining the proposed windfarm site to provide baseline water quality, fisheries and riparian habitat data. Watercourses in the vicinity were surveyed by an ecologist on the 11th of June and the 22nd August 2012.The survey results will provide a baseline for future monitoring to ensure that the existing water and habitat quality of watercourses within and adjacent to the site are maintained during the construction and operational phase of the proposed windfarm development.

The study area is situated on hills or drumlins with a number of streams that support the upper reaches of the Owenbeg, Clodiagh and Turraheen River catchments which drain to the Suir. Tributaries of the Clodiagh River drain the northern and central locations of the site while the southern and eastern portion of the site are drained by tributaries of the Owenbeg and Turraheen Rivers. The westerly cluster comprised of turbines T17 and T18 is drained by an unnamed tributary of the Aughvana River and is the only part of the overall site that forms part of the Shannon River Basin District.

A total of six sampling points were strategically identified at locations within the catchment area of the proposed Upperchurch Windfarm site in order to assess and give an indication on the water quality in the immediate area surrounding the proposed site.Table 5 below details the Grid References and Q value of each sampling station on which the survey was undertaken.

TABLE 5 LIST OF SAMPLING STATIONS WITH Q VALUES

Sampling Station	Grid Reference	Location	Q Value
1	97973 61082	Unnamed stream (east of site) which flows to the Owenbeg River	Q3
2	97336 59293	Owenbeg river (east of site)	Q4
3	94363 59329	Unnamed stream (southern section of the site) which flows to the Turraheen River	Q4
4	95056 62330	Unnamed stream (central area of site) which flows to the Clodiagh River	Q4
5	94623 63001	Unnamed stream (northern section of the site) which flows to the Clodiagh River	Q4-5
6	93464 59759	Unnamed stream (southern section of the site) which flows to the Aughvana River	Q3

2.2.4.3 Physiochemical water quality

TABLE 6-6: PHYSIOCHEMICAL WATER QUALITY RECORDED AT THE UPPERCHURCH SITE, CO. TIPPERARY.

Parameter	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Salmonid Regulations S.I. No. 293 of 1988	Surface Water Regulations S.I. No. 272 of 2009
pH	7.5	7.6	7.2	7.7	7.6	7.7	>6 & <9	
Alkalinity, mg/L as CaCO3	72.5	62.9	91.1	81.0	56.6	119		
Temperature	11.28	11.98	10.03	12.29	12.46	12.10		
Suspended solids mg/L	3	2	6	<2	<2	18	<25	
BOD (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0	1.4	<5	<2.2
Nitrate(mg/L)N O3-N	1.08	0.73	2.07	1.23	0.65	1.95		
Nitrite	<0.005	<0.005	<.005	<.005	<.005	0.01	<0.05	

Parameter	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Salmonid Regulations S.I. No. 293 of 1988	Surface Water Regulations S.I. No. 272 of 2009
(mg/L)NO2-N								
Sulphate (mg/L)	5.14	4.85	5.70	4.78	4.56	4.36		
MRP, mg/L P	0.01	0.01	0.01	0.02	0.01	0.06		≤0.035
Total phosphorous P (mg/L)	0.09	<0.04	0.16	0.06	0.04	<0.04		
Total dissolved phosphorous P (mg/L)	0.09	<0.04	0.12	0.06	0.04	<0.04		
Particulate phosphorous (mg/L)	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04		
Ammonia	0.03	0.02	<0.02	0.03	0.02	<0.02	≤ 1	
Ammonia (unionised)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	≤ 0.02	
Metals								
Iron (mg/L)	0.251	0.146	0.025	0.089	0.110	0.16		
Aluminium (mg/L)	0.019	0.042	0.023	0.037	0.024	0.05		

Physiochemical water quality testing was undertaken on the 11th of June and 22nd of August 2012 at the same location as the Q value sampling to establish the baseline water quality of watercourses immediately downstream of the proposed windfarm.

Dissolved oxygen levels were >11mg/L in all the watercourses that were surveyed, indicating that all of the surface waters in the catchment areas had levels of oxygen capable of supporting healthy salmonid populations as per the Salmonid Water Regulations (SI No. 293 of 1988) .The pH levels at all sampling stations ranged between 7.5 and 7.7. These fall within the range >6 and <9 required under the Salmonid Water Regulations (S.I. No. 293 of 1988), required for balanced and healthy fish populations in the Salmonid Regulations.

Levels of unionised ammonia and nitrite recorded were within the thresholds specified in the Salmonid Regulations (S.I. No. 293 of 1988).Similarly the BOD levels were low with sites 1 through 5 inclusive, recording <1.0mg/L BOD and site 6 recording the highest levels; 1.4mg/L BOD. All sites were in compliance with the Salmonid Water Regulations.

Ortho-phosphate (MRP) levels were similar across sampling sites with 0.01mg/L levels recorded at sites 1, 2, 3 and 5 with site 4 recording 0.2mg/L and site 6 recording the highest levels of 0.06mg/L. Sites 1 through 5 levels are below the levels recommended in the Surface Water Regulations (S.I. No. 272 of 2009) meeting the requirements of the regulation, however site 6 exceeds the ≤0.035 recommended levels.

The suspended solid levels were low for streams 1 through 5, with levels recorded ranging from 2mg/L to 6mg/L. The value at sampling station 6 was the highest at 18 mg/L. All streams were in compliance with the threshold of <25mg/l required under the Salmonid Water Regulations (S.I. No. 293 of 1988).

2.2.5 Characteristics of the Project (Construction Phase)

2.2.5.1 Size, scale, area, land-take

The proposed windfarm site does not require land take from a Natura 2000 or Ramsar site. The proposed windfarm site is made up of four sections distributed in separate clusters over an overall area of approximately 12km^2. The total proposed site footprint is 110,210 m^2

2.2.5.2 Resource requirement

It is estimated that a total of 17,020m^3 of material will be required for the widening of existing tracks and the construction of new access tracks for the proposed development. It is estimated that construction of the hardstand areas will involve a total volume of 31,100m^3 of imported stone material. It is proposed to source the materials from at local registered quarries.

An average of 345m^3 of imported concrete will be required for each base.

2.2.5.3 Transportation requirements

New and upgrading of existing access tracks will be required to facilitate construction and turbine traffic during the construction, operational and decommissioning phases.

It is proposed that the turbine components will be delivered either from Dublin port or Foynes port. If the components are delivered from Dublin Port they will be transported west along the M7 to the Nenagh by-pass and turn onto the R498 at Knockalton Upper. If the turbine components are delivered from Foynes Port they will be transported east on the M7 to the Nenagh by-pass and turn right on the R498 at Knockalton Upper. The traffic will then travel the R498 into Thurles and turnaround at the Tipperary Institute roundabout and travel back up the R498 for 2.5km in order to effect the turn left onto the R503 after the Racecourse. The vehicles will travel west along the R503 for 17.1km and turn left onto the proposed Upperchurch Windfarm site entrance at an existing field gate at Graniera. The turbine deliveries and construction traffic will also use entrances from the local roads at Knockmaroe, Knockcurraghbola Commons, Shevry, Grousehall and Knocknamena Commons. It is expected that construction materials will be transported along a similar route.

2.2.5.4 Equipment requirement

In association with the above materials the following is a non-exhaustive typical list of plant and equipment that may be required for construction:

- 30-50T Excavators;
- Low ground pressure excavators (Bogmaster);
- Mobile cranes for construction;
- Rebar/shuttering/precast units/conc pipes/box culverts;
- Cranes (1 main, 1 assist) Erection 120t to 800t;
- Dump trucks;
- Tractors and trailers;
- Double contained fuel bowsers;
- 12t Rollers;
- Crushers;
- Screener;
- Diesel powered generators; and
- Water bowsers.

2.2.5.5 Excavation requirements

Implementation of the development will result in the removal of soil, subsoil and rock in parts of the site in order to facilitate the construction of access roads, the upgrade of existing farm roads, the substation compound, crane hard standings and turbine bases. This soil will be reused within the construction site for backfilling around turbine bases and for landscaping post construction.

The volumes of material to be excavated are summarised in Table 7.

TABLE 7 VOLUMES OF MATERIAL TO BE EXCAVATED

ELEMENT	TOPSOIL (M^3)	PEAT (M^3)	SUBSOIL (M^3)
TURBINE T01	**540**	**-**	**4,281**
TURBINE T02	**527**	**-**	**3,832**
TURBINE T03	**481**	**-**	**2,160**
TURBINE T04	**540**	**-**	**4,281**
TURBINE T05	**-**	**570**	**5,318**
TURBINE T06	**540**	**-**	**4,281**
TURBINE T07	**545**	**-**	**4,433**
TURBINE T08	**518**		**3,255**
TURBINE T09	**545**	**-**	**4,433**
TURBINE T10	**507**	**-**	**3,160**
TURBINE T11	**498**	**-**	**2,725**
TURBINE T12	**550**	**-**	**4,798**
TURBINE T13	**540**	**-**	**4,281**
TURBINE T14	**-**	**520**	**3,603**
TURBINE T15	**520**	**-**	**3,603**

Element	Topsoil (m^3)	Peat (m^3)	Subsoil (m^3)
Turbine T16	**518**	**-**	**3,255**
Turbine T17	**505**	**-**	**2,928**
Turbine T18	**505**	**-**	**2,928**
Turbine T19	**498**	**-**	**2,725**
Turbine T20	**518**	**-**	**3,255**
Turbine T21	**505**	**-**	**2,928**
Turbine T22	**-**	**505**	**2,928**
Turbine T23	**507**	**-**	**3,160**
New roads	**13,050**	**900**	**0**
Widened roads	**2,070**	**360**	**0**
Sub-totals (m^3)	25,527	2,855	79,623
Total (m^3)	107,500		

2.2.5.6 Emissions during the lifetime of the project

Air pollutants from construction vehicles, plant, machinery or generators may include emissions of SO_2, NO_x, CO_2, and PM_{10} (particulates). Any traffic generated by the construction phase will be temporary and of short duration and may cause a temporary, slight, negative impact within the site.

There are no air pollutants or emissions associated with the operational phase of the windfarm. As a result there will be a neutral impact on the local area during the operational phase. The operation of the windfarm will have a positive impact on the national air and climate environment however, through the provision of pollution-free electricity.

2.2.5.7 Waste Management

From a waste management perspective the project can be divided into three phases

- Construction;
- Operation/Maintenance; and
- Decommissioning.

Construction phase waste may consist of hardcore, stone, concrete, steel reinforcement, shuttering timber and unused oil and diesel. This waste will be collected at the end of the construction phase and taken off site to be reused, recycled and disposed of in accordance with best practice procedures at an approved facility. Waste from toilets will be taken from site on a regular basis by approved contractors and disposed of in an authorised facility in accordance with best practice. Plastic waste will be taken for recycling by approved contractor and disposed or recycled at an approved facility.

Wastes arising during the operating phase of the project include but are not limited to lubricating oils, cooling oils and packaging from spare parts. The containment and disposal of such oils will be carried out in a safe manner by an approved contractor. Such operations will be carried out in accordance with the Waste Management (Hazardous Waste) Regulations, 1998. The remaining wastes will all be removed from site and reused, recycled or disposed of in an authorised facility in accordance with best practice.

Wastes generated during the decommissioning phase will be taken off site and disposed of appropriately.

2.2.5.8 Timescales

Once construction commences, it is estimated that the windfarm could be constructed within 8 months.

2.2.6 Description of construction

The first priority of the construction phase will be to construct the access road network, and associated drainage network, and upgrade the existing roads and the spine roads in particular so that they are capped with limestone or similar quality stone to reduce the potential for road degradation. Vehicular movements will be restricted to the footprint of the proposed development, particularly with respect to the newly constructed access roads.

The development is characterised by the following civil engineering works which will be undertaken to provide the necessary infrastructure to complete the windfarm:

- Construction of a temporary site compound;
- Construction of the access tracks and associated drainage;
- Construction of stream crossing;
- Construction of the turbine foundations;
- Construction of the hard stand areas for the turbine assembly and erection;
- Turbine and ancillary equipment transport to the site;
- Turbine erection;
- Construction of the electrical control building; and
- Laying of electrical cables.

2.2.6.1 Temporary site compound

A temporary site compound will be used at the site during the construction period for the safe storage of supplies and equipment, and the provision of toilet facilities (with temporary holding tank) and canteen facilities for construction staff. The holding tank will be emptied on a regular basis and taken to a wastewater treatment facility by a contractor with the appropriate waste collection permit. The compound and associated facilities will be removed on completion of construction and the area will be appropriately reinstated.

2.2.6.2 Access Roads

The construction phase of this project will require deliveries of material and turbines to the site. The access roads to the turbines and the site substation will consist of both existing tracks and newly constructed roads.

- Importation of stone from local quarries for the construction of access roads and hard standings.
- Construction of 8.0 km of 5.00m wide new roads; and
- Widening and upgrading of 3.6 km of existing farm roads (average 2m widening).

All new roads will be excavated, built up with suitable material and capped with suitable material.

2.2.6.3 Drainage

Site drainage has been considered in the Sediment and Erosion Plan detailed in **Appendix 15-I** of the EIS. This plan has been prepared to prevent sediment runoff and control erosion during the construction phase of the project. The plan has also been designed to minimise disturbance to the current hydrological regime and to minimise suspended sediment loading to watercourses during construction. Access tracks will be provided with drainage ditches to collect surface water runoff from the tracks and to ensure that road foundations are protected from standing water. Surface water drains will also be provided around hardstandings, foundations and the compound. Upslope drains will be constructed so as to keep clean water separate from runoff that may be contaminated by sediment. This is standard practice in the control of sediments in windfarm construction. Sediment traps will be used to ensure that all water discharged is clean.

2.2.6.4 Clearfelling

Prior to construction, clear-felling of approximately 4.35ha area of conifer plantation will be required to facilitate the construction the proposed windfarm and associated infrastructure.

2.2.6.5 Wind Turbine foundations and hardstands

Excavation for the construction of 22 turbine bases with a minimum depth of 2.00m and 225m^2 plan area and hardstands with and excavation depth of 0.60m and 1,040m^2 plan area;

Each wind turbine will have a reinforced concrete base pad foundation with a central upstand above the base, which will support the tower. The foundation pad will bear onto rock or other such suitable bearing stratum.

The turbine foundations be backfilled with the materials removed during excavation. The surface vegetation and topsoil layer will be removed and stored adjacent to the foundation site, whilst excavation of the foundation progresses. This stored material will be used during reinstatement of the foundation area following the construction of each wind turbine foundation.

Erection of 22 turbines with hub heights of up to 80m and maximum tip height of up to 126.60m. Once erected the wind turbines will operate automatically, requiring visits on a periodic basis only. These visits, primarily for turbine servicing, will typically be made using four-wheel drive vehicles which will keep to access roads.

2.2.6.6 Sub-station and grid connection

Construction of an electrical substation compound and installation of associated equipment and laying of electrical cable between turbines and the substation compound will be required. The substation compound will measure 64m x 41m. The cabling from the proposed turbines of the Upperchurch Windfarm will link to the proposed sub-station on site. The cables linking the turbine transformers will be located underground to reduce visual impact. A trench of at least 1m deep and 0.5m wide will accommodate these cables.

2.2.7 Operation, decommissioning and restoration

The windfarm will have a projected commercial lifespan of 20-25 years during which time it will produce pollution free electricity with the capacity to provide power, generating 150 million kWh, for up to 23,070 homes. There will be maintenance during the operating period with operating and maintenance personnel typically using four-wheel drive vehicles to visit the site. The system may be readily upgraded at the end of its commercial life, or alternatively decommissioned.

If it is decided to decommission the windfarm at the end of its lifespan, the turbines, transformers, meteorological monitoring mast and substation will be dismantled and removed from the site following consultation with North Tipperary County Council. All associated hardstand areas will be remediated to match the surrounding landcover at the time. An environmental assessment will be undertaken at that time to ascertain whether or not it would be more or less environmentally damaging to remove or keep in place the underground cables and access tracks. All materials removed from the site will be treated in accordance with best practice waste management procedures and will be in consultation with North Tipperary County Council.

2.2.8 Identification of other projects or plans

There are a number of existing windfarms to the west and south of the site. These are listed at Table 8, below.

TABLE 8: NEIGHBOURING WINDFARMS IN THE VICINITY EXISTING AND PERMITTED.

Wind farm	Number of Turbines	Distance and direction from proposed site	Status
Knockastanna, Co Limerick	4	8.1km S	Operating
Mienvee	1	9km SW	Operating
Garracummer	15	3.5km SW	In Construction
Falleennafinoga	2	5.5km S	In Construction
Hollyford	3	5.5km S	Permitted
Glencarbry	9	6.3kn S	Permitted
Glenough	14	3.2kn S	Operating
Cappagh White	18	8.5km S	Permitted
Curraghgraigue	6	9.5km N	Operating
Knockmeale	2	8.2km NW	Permitted
Knockastanna, Co Limerick	4	8.1km S	Operating

Other relevant projects and plans include:

- **Agriculture** is one of the main land uses within the area. Land reclamation, drainage, reseeding, fertilisation, and intensive grazing has transformed the landscape of this area.

- Forestry occurs within sections of the site**,** consisting of either mature or young conifer plantations. Felling has been carried out in sections and has been replanted with the youngest observed at the location of Turbine 22 standing at 1.5 meters high.

2.3 IDENTIFICATION OF NATURA 2000 SITES

2.3.1 Zone of impact influence

The screening stage of AA involves compiling a 'long list' of European sites within a zone of potential impact influence for later analysis which may or may ultimately not be impacted upon by the proposal. All Natura 2000 sites within 15km of the proposal location will be characterised in the context of the rationale for designation and qualifying features, in accordance with NPWS guidance. Following this, the potential impacts associated with the proposal will be identified before an assessment is made of the likely significance of these impacts. Finally, in the conclusion of the screening stage, the Natura 2000 sites within 15km whose integrity will not be adversely impacted will be ruled out. If screening indicates sites will be affected it will be necessary to proceed to Stage 2, Appropriate Assessment for a more detailed assessment.

2.3.2 Identification of Natura 2000 and Ramsar sites

Adopting the precautionary principle in identifying potentially affected European sites, it has been decided to include all cSACs and SPAs/Ramsar sites, within a 15km radius of the proposed windfarm site. The Convention on Wetlands of International Importance especially as Waterfowl Habitat, more commonly known as the Ramsar Convention, was ratified by Ireland in 1984. Ramsar sites are also subject to AA screening. Although not specifically required, it would be considered best practice to include Ramsar sites (classified under the Ramsar Convention 1971) in the appropriate assessment process[2].

Table 9 below lists all designated cSACs and classified SPA sites (referred to as designated sites from hereon in) within 15km of the proposal site including their proximity.

TABLE 9: DESIGNATED CONSERVATION SITES WITHIN A 15KM RADIUS OF PROPOSAL SITE

No.	Designated Site	Site Code	Proximity of site to nearest point of designated site
1	Slievefelim to Silvermines Mountains SPA	004165	Adjacent to the western boundary of turbines T17 to T21.
2	Anglesey Road cSAC	002125	2.55km south west of the proposed windfarm site.
3	Lower River Shannon cSAC	002165	2.7km west of the site boundary (T17 to T21).
4	Lower River Suir cSAC	002137	2.8km east of the proposed windfarm site and approximately 4.1km downstream.
5	Bolingbrook hill SAC	002124	6.9km north west of the site boundary (T17 to T21).
6	Keeper Hill SAC	001197	10.7km north west of the site

[2] EPA, A Note on Waste Water Discharging Licence Appropriate Assessments

No.	Designated Site	Site Code	Proximity of site to nearest point of designated site
			boundary (T17 to T21).
7	Silvermines mountains West SAC	002258	11.25km north west of the site boundary (T17 to T21).
8	Kilduff, Devilsbit Mountain SAC	000934	13.35km north east of the site boundary (T9 to T16)
9	Philipston Marsh SAC	001847	13.6km south west of the site boundary (T1 to T8).

2.3.3 Characteristics of Natura 2000 and Ramsar sites

Table 10, below, characterises the cSACs, SPA and Ramsar sites that lie within 15km of the proposal site by listing the qualifying features and other conservation interests (information pertaining to designated sites is from site synopses, conservation objectives and other information available on www.npws.ie and on the Ramsar website). The qualifying Features of Interest are the primary reasons for the European sites designation, for instance the endangered species that occupy the SAC; rare habitats that occur there; or threatened birds that breed or over-winter in the SPA.

TABLE 10: DESIGNATED CONSERVATION SITES WITH QUALIFYING FEATURES OF CONSERVATION INTEREST

Designated Site	Site Code	Features of Interest
Slievefelim to Silvermines Mountains SPA	004165	Hen Harrier (*Circus cyaneus*) [A082]
Anglesey Road cSAC	002125	Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe) [6230]
Lower River Shannon cSAC	002165	Freshwater pearl mussel (*Margaritifera margaritifera*) [1029] Sea lamprey (*Petromyzon marinus*) [1095] Brook lamprey (*Lampetra planeri*) [1096] River lamprey (*Lampetra fluviatilis*) [1099] Salmon (*Salmo salar*) [1106] Sandbanks which are slightly covered by sea water all the time [1110] Estuaries [1130] Mudflats and sandflats not covered by seawater at low tide [1140] Coastal lagoons [1150] Large shallow inlets and bays [1160] Reefs [1170] Perennial vegetation of stony banks [1220] Vegetated sea cliffs of the Atlantic and Baltic coasts [1230] Salicornia and other annuals colonizing mud and sand [1310] *Spartina* swards (*Spartinion maritimae*) [1320] Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330] Bottle-nosed dolphin (*Tursiops truncatus*) [1349] Otter (*Lutra lutra*) [1355] Mediterranean salt meadows (*Juncetalia maritimi*) [1410] Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation [3260] Molinia meadows on calcareous, peaty or clavey-silt-laden soils (*Molinion caeruleae*) [6410] Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*) [91E0]
Lower River Suir cSAC	002137	Freshwater pearl mussel (*Margaritifera margaritifera*) [1029] White-clawed crayfish (*Austropotamobius pallipes*) [1092] Sea lamprey (*Petromyzon marinus)* [1095] Brook lamprey (*Lampetra planeri*) [1096] River lamprey (*Lampetra fluviatilis*) [1099] Allis shad (*Alosa alosa*) [1102] Twaite shad (*Alosa fallax fallax*) [1103] Salmon (*Salmo salar*) [1106] Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)

Designated Site	Site Code	Features of Interest
		[1330] Otter (*Lutra lutra*) [1355] Mediterranean salt meadows (*Juncetalia maritimi*) [1410] Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation [3260] Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels [6430] Old sessile oak woods with *Ilex* and Blechnum in British Isles [91A0] Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*) [91E0] *Taxus baccata* woods of the British Isles [91J0]
Bolingbrook hill SAC	002124	Northern Atlantic wet heaths with *Erica tetralix* [4010] European dry heaths [4030] Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe) [6230]
Keeper Hill SAC	001197	Northern Atlantic wet heaths with *Erica tetralix* [4010] Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe) [6230] Blanket bog (*active only) [7130]
Silvermines Mountains West SAC	002258	Northern Atlantic wet heaths with *Erica tetralix* [4010] European dry heaths [4030] Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe) [6230] Blanket bog (*active only) [7130]
Kilduff, Devilsbit Mountain SAC	000934	European dry heaths [4030] Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe) [6230]
Philipston Marsh SAC	001847	Transition mires and quaking bogs [7140] Alkaline fens [7230]

Conservation Objectives of the sites outlined in Table 10 above are included in **Appendix 13-II B**.

2.3.4 Conservation Objectives

According to the Habitat's Directive, the *conservation status of a natural habitat* will be taken as 'favourable' when:

- its natural range and areas it covers within that range are stable or increasing, and

- the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and
- the conservation status of its typical species is favourable as defined below.

According to the Habitat's Directive, the *conservation status of a species* means the sum of the influences acting on the species concerned that may affect the long-term distribution and abundance of its populations. The *conservation status* will be taken as 'favourable' when:

- population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, *and*
- the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, *and*
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

These conservation objectives are of a wide-ranging nature and most of the conservation objectives developed by NPWS for Natura 2000 sites area are adapted from these and are published on line by the NWPS as 'Generic Conservation Objectives' documents. The available documents are included in **Appendix 13-II B**. Site specific Conservation Management Plans have been developed for some sites listed at Table 10, above, namely Bolingbrook Hill, Keeper Hill and Kilduff, Devilsbit Mountain SACs and these documents are published on line at www.npws.ie.

Figures 13-II-1 and **Figure 13-II-2** at the end of Chapter 13 show the Natura 2000 Sites located within 15 km of the proposed development site. No Ramsar Sites were recorded within 15 km of the proposed development. Natural Heritage Areas (NHAs) and proposed Natural Heritage Areas (pNHAs) have been omitted from the list as they outside the scope of the Appropriate Assessment. The potential impact to these sites is discussed in Ecology chapter of the main EIS document Chapter 13.

2.3.5 Identification of Potential Impacts

Potential impacts are identified in this section. Only those features of the development that have the potential to impact on qualifying features, conservation interests and conservation objectives of the identified Natura 2000 sites are considered.

Description of elements of the project likely to give rise to impacts on Natura 2000 sites.	• Use of plant machinery and associated fuels and oils. • Increased levels of disturbance due to human activities during the construction phase. • Waste generation during construction phase. • Excavations for turbine bases, roads etc. • Extension of the existing road network footprint and associated drainage. • Near and in stream works required for road network stream crossings. • Felling of 4.35 ha. of pre-thicket and post thicket conifer plantation
Describe any likely direct, indirect or secondary impacts of the project (either alone or in combination with other plans or projects) on Natura 2000 sites by virtue of: • *Size and scale;* • *Land-take;* • *Distance from Natura 2000 Site or key features of the Site;* • *Resource requirements;* • *Emissions;* • *Excavation requirements;* • *Transportation requirements;* • *Duration of construction, operation etc.; and* • *Other.*	• Construction phase excavations to be conducted within the catchment of a headwater of an SAC designated for the protection of riparian habitats and species have the potential to initiate point source pollution events. • Soil exposed during construction phase could potentially be transferred via surface water runoff to water courses. • Construction of road network, and its associated drainage network, introduces a potential pollution pathway enabling the transfer of pollutants to ground and surface water during construction and operational phases. • Fugitive noise from construction phase activity and human presence could create disturbance impacts on animal species present within the zone of impact influence. • **Movement of plant and machinery**: Most of the traffic movement within the site will be over existing excavated tracks. • **Ground stability**: The approach to and method of excavation of rock and earth materials is very important for ground stability. Interference with the existing ground stability conditions by inappropriate excavation methods such as continuous vehicular movement over excavated soil must be mitigated by appropriate construction methods. • **Storage, Stockpiles and Waste Generation**: Of significance during the construction phase of the project is the handling of excavated materials, their

	storage and re-use. There is potential for negative direct and indirect short-term minor impact on ground stability and negative direct and indirect short-term moderate to significant impact on water quality, for example slope failure due to excessive loading (surcharge) > 1m in height and the resultant release of peat washings and suspended solids to the surface water system. • **Use of Fuels and Oils:** The plant equipment that will be used during the construction stage is run on hydrocarbons. This implies that mobile equipment will require regular refuelling from a fuelling station, which is likely to be stored on site or will be supplied by a truck / tanker that will be scheduled to re-fuel the plant directly. This poses the potential for spillage and leakage of hydrocarbons from plant equipment and associated transfer stations during the construction phase of this project.
Describe any likely changes to the site arising as a result of: • *Reduction of habitat area;* • *Disturbance of key species;* • *Habitat or species fragmentation;* • *Reduction in species density;* • *Changes in key indicators of conservation value; and* • *Climate change.*	• Due to the alteration of the environment rainwater falling on the development footprint will follow a new drainage regime. • Detrimental water quality impacts could cause significant changes in the water quality influencing the conservation status of the aquatic habitats and designated species creating disturbance or displacement impacts.
Describe any likely impacts on the Natura 2000 site as a whole in terms of: • *Interference with the Key relationships that define the structure of the site; and* • *Interference with key relationships that define the function of the site.*	Detrimental water quality impacts could cause significant interference with the key relationships that define the structure and function of the site.
Describe from the above those elements of the project, or combination of elements, where the above impacts are likely to be significant or where the scale of	The combined elements of the construction phase could potentially create significant impacts in aquatic habitats in streams adjacent to the site and in the Natura 2000 site to which they drain.

magnitude of impacts is not known.	

2.4 ASSESSMENT OF SIGNIFICANCE OF POTENTIAL IMPACTS

This section considers the list of sites identified in section 2.3 above. The magnitude/extent, probability and duration of significant impacts affecting these sites are examined in the following sections.

It is considered that the proposed windfarm development does not include any element that has the potential to significantly alter the favourable conservation status of species and habitats for which certain Natura 2000 sites, and considered in this document, are designated. It is considered that these sites are outside the zone of impact influence of the proposed windfarm and that the conditions required to initiate a potential 'source-pathway-target' vector connecting the proposed windfarm to these designated sites will not be created. It is further considered that no potential impact pathway connects these designated sites to the location of the proposed works and, therefore, it is objectively concluded that no impact on these sites is reasonably foreseeable as a result of the proposed windfarm. These sites are listed below and will not be considered further in this document.

- **Anglesey Road cSAC (002125)**
- **Bolingbrook hill SAC (002124)**
- **Kilduff, Devilsbit Mountain SAC (000934)**
- **Silvermines mountains West SAC (002258)**
- **Keeper Hill SAC (001197)**
- **Philipston Marsh SAC (001847)**

Therefore, the assessment of significance of potential impacts that follows focuses on the remaining designated sites. These sites are:

- **Lower River Shannon cSAC (002165)**
- **Lower River Suir cSAC (002137)**
- **Slievefelim to Silvermines Mountains SPA (004165)**

The potential for significant impacts on the remaining three Natura 2000 Sites arising from the proposal was determined based on a number of indicators including:

- Habitat loss;
- Habitat alteration;
- Habitat or species fragmentation;
- Disturbance and/or displacement of species;
- Water quality and resource.

2.4.1 Habitat Loss and Alteration

The proposal considered in this document does not require any land take from any Natura 2000 or Ramsar site. It is considered that no significant habitat loss or alteration impacts, within any of the designated sites considered in this document, are reasonably foreseeable as a result of the proposal considered in this document. Indirect impacts on aquatic habitats are assessed in section 2.4.3 below.

2.4.2 Habitat or Species Fragmentation

Bearing in mind the size, scale and duration of the proposed windfarm and its location relative to the relevant designated sites, it is considered that no significant habitat or species fragmentation impacts are reasonably foreseeable within any of the designated sites considered in this document,as a result of the proposal considered in this document.

2.4.3 Disturbance and/or displacement of species

The species, for which the Natura 2000 sites are designated, can be separated into Aquatic, Terrestrial/Riparian and Avian categories as follows:

2.4.3.1 Aquatic

- Sea lamprey (*P. marinus*) [***Lower River Suir cSAC and Lower River Shannon cSAC***]
- Brook lamprey (*L. planeri*) [***Lower River Suir cSAC and Lower River Shannon cSAC***]
- River lamprey (*L. fluviatilis*) [***Lower River Suir cSAC and Lower River Shannon cSAC***]
- Salmon (*S.salar*) [***Lower River Suir cSAC and Lower River Shannon cSAC***]
- Freshwater pearl mussel (*M. margaritifera*) [***Lower River Suir cSAC and Lower River Shannon cSAC***]
- White-clawed crayfish (*A. pallipes*) [***Lower River Suir cSAC***]
- Allis shad (*Alosa alosa*) [***Lower River Suir cSAC***]
- Twaite shad (*A. fallax fallax*) [***Lower River Suir cSAC***]
- White-clawed crayfish (*A. pallipes*) [***Lower River Suir cSAC***]
- Bottle-nosed dolphin (*T. truncatus*) [1349] [***Lower River Shannon* cSAC**]

Aquatic species are considered further in section 2.5.4 Water Quality.

2.4.3.2 Terrestrial/Riparian

- Otter (L. lutra) [Lower River Suir cSAC and Lower River Shannon cSAC]

2.4.3.3 Avian

- Hen harrier (Circus cyaneus) [Slievefelim to Silvermines Mountains SPA]

There is the potential that some of the species maybe impacted by the proposed development and this will be considered further in the Natura Impact Statement.

2.4.4 Water Quality

The proposed site drains into streams that form the upper reaches of the Turraheen, Owenbeg, Clodiagh and Aughvana Rivers. The first three of these rivers form part of the South Eastern River Basin District and ultimately join the River Suir [The Lower River Suir cSAC (Site Code:002137)]to the southeast. The Aughvana River, which forms part of the Shannon River Basin District, joins the Mulkear River and ultimately flows into the River Shannon [Lower River Shannon cSAC (Site Code:002165)]. The watercourses both within and adjacent to the site boundary are tributaries of both the Lower River Suir and the Lower River Shannon cSAC.

No work will take place within 50m buffer zones of watercourses, except at clear span bridges or culverts and associated road construction. A total of three first order streams occur within the site boundary. One stream/river crossing will be required, approximately 254 m to the north of Turbine 4. All construction method statements will be prepared in consultation with Inland Fisheries Ireland.

Roadside drainage will be an integral part of the proposed Upperchurch Windfarm considered in this document. The construction of new roads and the upgrading and widening of existing farm roads will comprise of an integrated set of drainage and sediment control measures which will allow pollution control attenuation prior to discharge across ground rather than to surface water, thereby preventing water runoff from entering watercourses directly.

While the water quality in the Lower River Suir cSAC and the Lower River Shannon cSAC is not in itself a feature of qualifying interest of the SACs it is the case that adverse impacts to their water chemistry could have indirect impacts on the conservation interests of the site; for example by affecting the distribution and density of white-clawed crayfish and the Fresh water pearl mussel or the distribution and density of salmonids which in turn could, potentially, affect the availability of prey for otter.

2.4.4.1 Lower River Suir cSAC (Site Code: 002137)

Most of the Upperchurch site is within the South Eastern River Basin District and drains to the Owenbeg River and ultimately to the River Suir. The River Suir Catchment covers a large area of 3,546km^2, which represents approximately 4% of the land area of the island of Ireland. The catchment includes extensive lowland areas, particularly along the major river valleys such as those of the Suir, the Aherlow, the Multeen and the Anner; and upland areas including parts the Comeragh Mountains, the Knockmealdown Mountains and the Galtee Mountains, rising to an altitude of 919m at Galtymore.

A number of fish species listed under Annex II of the EU Habitats Directive occur within the Suir catchment. These include Atlantic salmon (*S.salar*). All three lamprey species: sea lamprey (*Petromyzon marinus*), river lamprey (*Lampreta fluviatilis*) and brook lamprey (*Lampetra planeri*), which are likely to occur throughout much of the catchment. Allis shad (*Aloso aloso*) and twaite shad (*Alosa fallax fallax*) which occur in Waterford Harbour and tidal sections of the lower River Suir at least as far upstream as Carrick-on-Suir.

A number of protected invertebrates also occur within the Suir catchment which include the freshwater pearl mussel (*Margaritifera margaritifera*) and the White clawed crayfish (*A. pallipes*).

A fishery survey of the River Suir Catchment and Management Recommendations was prepared by the Regional Fisheries Board on behalf of the SE Region Fisheries Board in 2006. The major objective of the assessment was to establish the status of fish stocks in relation to the ecology of the Suir and its tributaries, and to use this data to generate focused management programmes. The Suir is recognised as a premier brown trout angling fishery and also a major salmon fishery. In 2005 the Suir was ranked as the 4th best salmonid river in Ireland, based on angling returns (CFB, 2006).

2.4.4.2 Lower River Shannon cSAC (Site Code: 002165)

The south western boundary of the proposed Upperchurch is within the Shannon River Basin District and drains to the Aughvana River and ultimately to the Mulkear River which is part of the Lower River Shannon cSAC.

The Lower River Shannon cSAC is a very large site stretching along the Shannon valley from Killaloe to Loop Head/ Kerry Head, a distance of some 120 km. 4 species of fish listed on Annex II of the EU Habitats Directive are found within the site. These are Sea Lamprey (*Petromyzon marinus*), Brook Lamprey (*Lampetra planeri*), River Lamprey (*Lampetra fluviatilis*), and Salmon (*Salmo salar*). The three lampreys and Atlantic salmon have all been observed spawning in the lower Shannon or its tributaries. Freshwater Pearl-mussel (*Margaritifera margaritifera*), a species listed on Annex II of the EU Habitats Directive, occurs abundantly in parts of the Cloon River.

2.4.4.3 Conclusion

With regard to the conservation interests of the Lower River Shannon cSAC and the Lower River Suir cSAC it is noted that there is the potential for an unmitigated impact as a result of the proposed development. This impact and proposed mitigations are discussed further in the Natura Impact Statement.

2.5 CONCLUSION OF SCREENING STAGE

In conclusion, to determine the potential impacts, if any, of the proposed windfarm on nearby Natura 2000/Ramsar sites, a screening process for AA was undertaken. The proposed development is within 15km of 9 Natura 2000 Sites. There are no Ramsar sites within 15km of the proposed development.

In concluding the above assessments of significance, it has been shown that there will be no potential impact to the following sites as a result of the proposed development:

- **Anglesey Road cSAC (002125)**
- **Bolingbrook hill SAC (002124)**
- **Kilduff, Devilsbit Mountain SAC (000934)**
- **Silvermines mountains West SAC (002258)**
- **Keeper Hill SAC (001197)**
- **Philipston Marsh SAC (001847)**

However, the proposed project could have potential negative ecological affects on three Natura Sites namely the *Lower River Shannon cSAC, Lower River Suir cSAC* and *Slievefelim to Silvermines Mountains SPA.*

Hence, the recommendation of the screening process is to proceed to Stage 2; Statement for Appropriate Assessment for three Natura 2000 Sites:

1. **Lower River Shannon cSAC (Site code: 002165);**
2. **Lower River Suir cSAC (002137); and**
3. **Slievefelim to Silvermines Mountains SPA (004165)**

3 Natura Impact Statement

3.1 INTRODUCTION

The main objective of Stage 2 of the Appropriate Assessment process is to consider the impact of the project or plan on the integrity of the Natura 2000 and Ramsar Sites, either alone or in combination with other projects, with respect to the conservation objectives of the sites and to identify and assess mitigation measures against any adverse effects the plan or project is likely to cause. Following the screening stage of the Appropriate Assessment, three Natura 2000 Sites were identified that may potentially be impacted by the proposed development are described below followed by further descriptions and details of the characteristics of the proposal. The potential impacts resulting from the unmitigated construction phase of the proposal, and from its operational phase, are then discussed in relation to the conservation objectives of the sites. Mitigation measures where appropriate are presented in below in Section 3.7.

3.1.1 Information sources

Information from the following sources was used to compile the Natura Impact Assessment:

- Winter Bird Survey – November 2010 to March 2011 (Chapter 13 of this EIS);
- Summer Bird Survey – April 2011 to August 2011 (Chapter 13 of this EIS);
- Habitat survey of the site – conducted by ecologists during the month of June 2012 (Chapter 13 of this EIS);
- Mammal survey conducted in conjunction with the habitat survey (Chapter 13 of this EIS);
- The geotechnical stability assessment (Chapter 14 of this EIS);
- National Biodiversity Centre Mapping System[3]
- National Parks and Wildlife Services (NPWS); and
- BirdWatch Ireland;

Publications that are used here and not referenced specifically include:

- Lynas, P., Newton, S.F., and Robinson, J.A. (2007). The status of birds in Ireland: an analysis of conservation concern 2008-2013. Irish Birds, 8: 149-167.
- Crowe, O., 2005. Ireland's Wetlands and their Waterbirds: status and distribution. BirdWatch Ireland.
- Gibbons, D.W., Reid, J.B. and R.A. Chapman, 1993. The New Atlas of Breeding Birds in Britain and Ireland: 1988-1991. British Trust for Ornithology, 1993.

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[3] Available at : http://maps.biodiversityireland.ie/#/Home [accessed on various dates July, August 2012]

- Dempsey, E and O' Clery, M. (2010). The Complete Field Guide to Ireland's Birds.
- Commission of the European Communities (2003). Interpretation manual of European Union Habitats-EUR 25. DG Environment-Nature and Biodiversity. Brussels.

3.2 DESCRIPTION OF THE PROJECT

A detailed description of the characteristics is outlined at section 2.4 above and further detail is presented in Chapter 7 – Construction Impacts and Employment of the EIS.

3.3 CHARACTERISTICS OF NATURA 2000 SITES

The NPWS site synopses of the Natura 2000 Sites are provided below to describe the site in more detail. The dates on which the site synopses were written are included at the end of each synopsis.

3.3.1 The Lower River Shannon candidate Special Area of Conservation (cSAC) (Site code: 002165) site synopsis (NPWS)

This very large cSAC stretches along the Shannon valley from Killaloe to Loop Head/ Kerry Head, a distance of some 120 km. The site thus encompasses the Shannon, Feale, Mulkear and Fergus Estuaries, the freshwater lower reaches of the River Shannon (between Killaloe and Limerick), the freshwater stretches of much of the Feale and Mulkear catchments and the marine area between Loop Head and Kerry Head. The Shannon and Fergus flow through Carboniferous limestone as far as Foynes, but west of Foynes Namurian shales and flagstones predominate (except at Kerry Head, which is formed from Old Red Sandstone). The eastern sections of the Feale catchment flow through Namurian Rocks and the western stretches through Carboniferous Limestone. The Mulkear flows through Lower Palaeozoic Rocks in the upper reaches before passing through Namurian Rocks, followed by Lower Carboniferous Shales and Carboniferous Limestone. The Mulkear River itself, immediately north of Pallas Green, passes through an area of Rhyolites, Tuffs and Agglomerates. Rivers within the subcatchment of the Feale include the Galey, Smearlagh, Oolagh, Allaughaun, Owveg, Clydagh, Caher, Breanagh and Glenacarney. Rivers within the sub-catchment of the Mulkear include the Killeenagarriff, Annagh, Newport, the Dead River, the Bilboa, Glashacloonaraveela, Gortnageragh and Cahernahallia.

The Shannon and Fergus Estuaries form the largest estuarine complex in Ireland. They form a unit stretching from the upper tidal limits of the Shannon and Fergus Rivers to the mouth of the Shannon estuary (considered to be a line across the narrow strait between Kilcredaun Point and Kilconly Point). Within this main unit there are several tributaries with their own ‘sub-estuaries’ e.g. the Deel River, Mulkear River, and Maigue River. To the west of Foynes, a number of small estuaries form indentations in the predominantly hard coastline, namely

Poulnasherry Bay, Ballylongford Bay, Clonderalaw Bay and the Feale or Cashen River Estuary. Both the Fergus and inner Shannon estuaries feature vast expanses of intertidal mudflats, often fringed with saltmarsh vegetation. The smaller estuaries also feature mudflats, but have their own unique characteristics, e.g. Poulnasherry Bay is stony and unusually rich in species and biotopes. Plant species are typically scarce on the mudflats, although there are some Eel-grass beds (Zostera spp.) and patches of green algae (e.g. Ulva sp. and Enteromorpha sp.). The main macro-invertebrate community, which has been noted from the inner Shannon and Fergus estuaries, is a Macoma- Scrobicularia-Nereis community. In the transition zone between mudflats and saltmarsh, specialised colonisers of mud predominate: swards of Common Cord-grass (Spartina anglica) frequently occur in the upper parts of the estuaries. Less common are swards of Glasswort (Salicornia europaea agg.). In the innermost parts of the estuaries, the tidal channels or creeks are fringed with species such as Common Reed (Phragmites australis) and Club-rushes (Scirpus maritimus, S. tabernaemontani and S. triquetrus). In addition to the nationally rare Triangular Club-rush (Scirpus triquetrus), two scarce species are found in some of these creeks (e.g. Ballinacurra Creek): Lesser Bulrush (Typha angustifolia) and Summer Snowflake (Leucojum aestivum).

Saltmarsh vegetation frequently fringes the mudflats. Over twenty areas of estuarine saltmarsh have been identified within the site, the most important of which are around the Fergus Estuary and at Ringmoylan Quay. The dominant type of saltmarsh present is Atlantic salt meadow occurring over mud. Characteristic species occurring include Common Saltmarsh Grass (Puccinellia maritima), Sea Aster (Aster tripolium), Thrift (Armeria maritima), Sea-milkwort (Glaux maritima), Sea Plantain (Plantago maritima), Red Fescue (Festuca rubra), Creeping Bent (Agrostis stolonifera), Saltmarsh Rush (Juncus gerardi), Long-bracted Sedge (Carex extensa), Lesser Seaspurrey (Spergularia marina) and Sea Arrowgrass (Triglochin maritima). Areas of Mediterranean salt meadows, characterised by clumps of Sea Rush (Juncus maritimus) occur occasionally. Two scarce species are found on saltmarshes in the vicinity of the Fergus Estuary: a type of robust Saltmarsh-grass (Puccinellia foucaudii), sometimes placed within the compass of Common Saltmarsh-grass (Puccinellia maritima) and Hard-grass (Parapholis strigosa). Saltmarsh vegetation also occurs around a number of lagoons within the site. The two which have been surveyed as part of a National Inventory of Lagoons are Shannon Airport Lagoon and Clonconeen Pool. Cloonconeen Pool (4-5 ha) is a natural sedimentary lagoon impounded by a low cobble barrier. Seawater enters by percolation through the barrier and by overwash. This lagoon represents a type which may be unique to Ireland since the substrate is composed almost entirely of peat. The adjacent shore features one of the best examples of a drowned forest in Ireland.

Aquatic vegetation in the lagoon includes typical species such as Beaked Tasselweed (Ruppia maritima) and green algae (Cladophora sp.). The fauna is not diverse, but is typical of a high salinity lagoon and includes six lagoon specialists (Hydrobia ventrosa, Cerastoderma glaucum, Lekanesphaera hookeri, Palaemonetes varians, Sigara stagnalis and Enochrus bicolor). In contrast, Shannon Airport Lagoon (2 ha) is an artificial saline lake with an *artificial barrier and sluiced outlet. However, it supports two Red Data Book species of Stonewort (Chara canescens and Chara cf. connivens).*

Most of the site west of Kilcredaun Point/Kilconly Point is bounded by high rocky sea cliffs. The cliffs in the outer part of the site are sparsely vegetated with lichens, Red Fescue, Sea Beet (Beta vulgaris), Sea Campion (Silene maritima), Thrift and Plantains (Plantago spp.). A rare endemic Sea Lavender (Limonium recurvum subsp. pseudotranswallinum) occurs on cliffs near Loop Head. Cliff-top vegetation usually consists of either grassland or maritime heath. The boulder clay cliffs further up the estuary tend to be more densely vegetated, with swards of Red Fescue and species such as Kidney Vetch (Anthyllis vulneraria) and Bird's-foot Trefoil (Lotus corniculatus).

The site supports an excellent example of a large shallow inlet and bay. Littoral sediment communities in the mouth of the Shannon Estuary occur in areas that are exposed to wave action and also in areas extremely sheltered from wave action. Characteristically, exposed sediment communities are composed of coarse sand and have a sparse fauna. Species richness increases as conditions become more sheltered. All shores in the site have a zone of sand hoppers at the top and below this each of the shores has different characteristic species giving a range of different shore types in the cSAC. The intertidal reefs in the Shannon Estuary are exposed or moderately exposed to wave action and subject to moderate tidal streams. Known sites are steeply sloping and show a good zonation down the shore. Well developed lichen zones and littoral reef communities offering a high species richness in the sublittoral fringe and strong populations of Paracentrotus lividus are found. The communities found are tolerant to sand scour and tidal streams. The infralittoral reefs range from sloping platforms with some vertical steps to ridged bedrock with gullies of sand between the ridges to ridged bedrock with boulders or a mixture of cobbles, gravel and sand. Kelp is very common to about 18m. Below this it becomes rare and the community is characterised by coralline crusts and red foliose algae.

Other coastal habitats that occur within the site include the following:

- *Stony beaches and bedrock shores - these shores support a typical zonation of seaweeds (Fucus spp., Ascophyllum nodosum and kelps).*
- *Shingle beaches - the more stable areas of shingle support characteristic species such as Sea Beet, Sea Mayweed (Matricaria maritima), Sea Campion and Curled Dock (Rumex crispus).*
- *Sandbanks which are slightly covered by sea water at all times – there is a known occurrence of sand/gravel beds in the area from Kerry Head to Beal Head.*
- *Sand dunes - a small area of sand dunes occurs at Beal Point. The dominant species is Marram Grass (Ammophila arenaria).*

Flowing into the estuaries are a number of tidal rivers. Freshwater rivers have been included in the site, most notably the Feale and Mulkear catchments, the Shannon from Killaloe to Limerick (along with some of its tributaries, including a short stretch of the Kilmastulla River), the Fergus up as far as Ennis, and the Cloon River. These systems are very different in character: the Shannon being broad, generally slow-flowing and naturally eutrophic; the Fergus being smaller and alkaline; while the narrow, fast-flowing Cloon is acid in nature. The Feale and Mulkear catchments exhibit all the aspects of a river from source to mouth. Seminatural habitats, such as wet grassland, wet woodland and marsh occur by the rivers, however, improved grassland is most common. One grassland type of particular conservation significance, Molinia meadows, occurs in several parts of the site and the examples at Worldsend on the River Shannon are especially noteworthy. Here are found areas of wet meadow dominated by rushes and sedges and supporting a diverse and species-rich vegetation, including such uncommon species as Blue-eyed Grass (Sisyrinchium bermudiana) and Pale Sedge (Carex pallescens). Floating river vegetation characterised by species of Water-crowfoot (Ranunculus spp.), Pondweeds (Potamogeton spp.) and the moss Fontinalius antipyretica are present throughout the major river systems within the site. The rivers contain an interesting bryoflora with Schistidium alpicola var. alpicola recorded from in-stream boulders on the Bilboa, new to county Limerick. Alluvial woodland occurs on the banks of the Shannon and on islands in the vicinity of the University of Limerick. The woodland is up to 50m wide on the banks and somewhat wider on the largest island. The most prominent woodland type is gallery woodland where White Willow (Salix alba) dominates the tree layer with occasional Alder (Alnus glutinosa). The shrub layer consists of various willow species with sally (Salix cinerea ssp. oleifolia) and what appear to be hybrids of S. alba x S. viminalis. The herbaceous layer consists of tall perennial herbs. A fringe of Bulrush (Typha sp.) occurs on the riverside of the woodland. On slightly higher ground above the wet woodland and on the raised embankment remnants of mixed oak-ash-alder woodland occur. These are poorly developed and contain numerous exotic species but locally there are signs that it is invading open grassland. Alder is the principal tree species with occasional Oak (Quercus robur), Elm (Ulmus glabra, U. procera), Hazel (Corylus avellana), Hawthorn (Crataegus monogyna) and the shrubs Guelder-rose (Viburnum opulus) and willows. The ground flora is species-rich. Woodland is infrequent within the site, however Cahiracon Wood contains a strip of old Oak woodland. Sessile Oak (Quercus petraea) forms the canopy, with an understorey of Hazel and Holly (Ilex aquifolium). Great Wood-rush (Luzula sylvatica) dominates the ground flora. Less common species present include Great Horsetail (Equisetum telmeteia) and Pendulous Sedge (Carex pendula). In the low hills to the south of the Slievefelim mountains, the Cahernahallia River cuts a valley through the Upper Silurian rocks. For approximately 2 km south of Cappagh Bridge at Knockanavar, the valley sides are wooded. The woodland consists of Birch (Betula spp.), Hazel, Oak, Rowan (Sorbus aucuparia), some Ash (Fraxinus excelsior) and Willow (Salix spp.). Most of the valley is not grazed by stock, and as a result the trees are regenerating well. The ground flora feature prominent Greater wood-rush and Bilberry (Vaccinium myrtillus) with a typical range of woodland herbs. Where there is more light available, Bracken (Pteridium aquilinum) features. The valley sides of the Bilboa and Gortnageragh Rivers, on higher ground north *east of Cappamore, support patches of semi-natural broadleaf woodland dominated by Ash, Hazel, Oak and Birch. There is a good scrub layer with Hawthorn, Willow, Holly and Blackthorn (Prunus spinosa) common. The herb layer in these woodlands is often open with a typically rich mixture of woodland herbs and ferns. Moss species diversity is high. The woodlands are ungrazed. The hazel is actively coppiced in places.*

There is a small area of actively regenerating cut away raised bog at Ballyrorheen. It is situated approx. 5 km north west of Cappamore Co. Limerick. The bog contains some wet areas with good moss (Sphagnum) cover. Species of particular interest include the Cranberry (Vaccinium oxycoccos) and the White Sedge (Carex curta) along with two other regionally rare mosses including S. fimbriatum. The site is being invaded by Birch (Betula pubescens) scrub woodland. Both commercial forestry and the spread of rhododendron has greatly reduced the overall value of the site. A number of plant species that are Irish Red Data Book species occur within the site - several are protected under the Flora (Protection) Order, 1999:

- *Triangular Club-rush (Scirpus triquetrus) - in Ireland this protected species is only found in the Shannon Estuary, where it borders creeks in the inner estuary.*
- *Opposite-leaved Pondweed (Groenlandia densa) - this protected pondweed is found in the Shannon where it passes through Limerick City.*
- *Meadow Barley (Hordeum secalinum) - this protected species is abundant in saltmarshes at Ringmoylan and Mantlehill.*
- *Hairy Violet (Viola hirta) - this protected violet occurs in the Askeaton/Foynes area.*
- *Golden Dock (Rumex maritimus) - noted as occurring in the River Fergus Estuary.*
- *Bearded Stonewort (Chara canescens) - a brackish water specialist found in Shannon Airport lagoon.*
- *Convergent Stonewort (Chara connivens) - presence in Shannon Airport Lagoon to be confirmed.*

Overall, the Shannon and Fergus Estuaries support the largest numbers of wintering waterfowl in Ireland. The highest count in 1995-96 was 51,423 while in 1994-95 it was 62,701. Species listed on Annex I of the E.U. Birds Directive which contributed to these totals include: Great Northern Diver (3; 1994/95), Whooper Swan (201; 1995/96), Pale-bellied Brent Goose (246; 1995/96), Golden Plover (11,067; 1994/95) and Bar-tailed Godwit (476; 1995/96). In the past, three separate flocks of Greenland White-fronted Goose were regularly found but none were seen in 1993/94. Other wintering waders and wildfowl present include Greylag Goose (216; 1995/96), Shelduck (1,060; 1995/96), Wigeon (5,976; 1995/96); Teal (2,319; 1995-96); Mallard (528; 1995/96), Pintail (45; 1995/96), Shoveler (84; 1995/96), Tufted Duck (272; 1995/96), Scaup (121; 1995/96), Ringed Plover (240; 1995/96), Grey Plover (750; 1995/96), Lapwing (24,581; 1995/96), Knot (800; 1995/96), Dunlin (20,100;

1995/96), Snipe (719, 1995/96), Black-tailed Godwit (1062; 1995/96), Curlew (1504; 1995/96), Redshank (3228; 1995/96), Greenshank (36; 1995/96) and Turnstone (107; 1995/96). A number of wintering gulls are also present, including Black-headed Gull (2,216; 1995/96), Common Gull (366; 1995/96) and Lesser Black-backed Gull (100; 1994/95). This is the most important coastal site in Ireland for a number of the waders including Lapwing, Dunlin, Snipe and Redshank. It also provides an important staging ground for species such as Black-tailed Godwit and Greenshank. A number of species listed on Annex I of the E.U. Birds Directive breed within the cSAC site. These include Peregine Falcon (2-3 pairs), Sandwich Tern (34 pairs on Rat Island, 1995), Common Tern (15 pairs: 2 on Sturamus Island and 13 on Rat Island, 1995), Chough (14-41 pairs, 1992) and Kingfisher. Other breeding birds of note include Kittiwake (690 pairs at Loop Head, 1987) and Guillemot (4010 individuals at Loop Head, 1987).

There is a resident population of Bottle-nosed Dolphin in the Shannon Estuary consisting of at least 56-68 animals (1996). This is the only known resident population of this E.U. Habitats Directive Annex II species in Ireland. Otter, a species also listed on Annex II of this directive, is commonly found on the site. Five species of fish listed on Annex II of the E.U. Habitats Directive are found within the site. These are Sea Lamprey (Petromyzon marinus), Brook Lamprey (Lampetra planeri), River Lamprey (Lampetra fluviatilis), Twaite Shad (Allosa fallax fallax) and Salmon (Salmo salar). The three lampreys and Salmon have all been observed spawning in the lower Shannon or its tributaries. The Fergus is important in its lower reaches for spring salmon while the Mulkear catchment excels as a grilse fishery though spring fish are caught on the actual Mulkear River. The Feale is important for both types. Twaite Shad is not thought to spawn within the site. There are few other river systems in Ireland which contain all three species of Lamprey. Two additional fish of note, listed in the Irish Red Data Book, also occur, namely Smelt (Osmerus eperlanus) and Pollan (Coregonus autumnalis pollan). Only the former has been observed spawning in the Shannon. Freshwater Pearl-mussel (Margaritifera margaritifera), a species listed on Annex II of the E.U. Habitats Directive, occurs abundantly in parts of the Cloon River. There is a wide range of landuses within the site. The most common use of the terrestrial parts is grazing by cattle and some areas have been damaged through overgrazing and poaching. Much of the land adjacent to the rivers and estuaries has been improved or reclaimed and is protected by embankments (especially along the Fergus Estuary). Further, reclamation continues to pose a threat as do flood relief works (e.g. dredging of rivers). Gravel extraction poses a major threat on the Feale. In the past, Cord-grass (Spartina sp.) was planted to assist in land reclamation. This has spread widely, and may oust less vigorous colonisers of mud and may also reduce the area of mudflat available to feeding birds.

Domestic and industrial wastes are discharged into the Shannon, but water quality is generally satisfactory - except in the upper estuary, reflecting the sewage load from Limerick City. Analyses for trace metals suggest a relatively clean estuary with no influences by industrial discharges apparent. Further industrial development along the Shannon and water polluting operations are potential threats.

Fishing is a main tourist attraction on the Shannon and there are a large number of Angler Associations, some with a number of beats. Fishing stands and styles have been erected in places. The River Feale is a designated Salmonid Water under the E.U. Freshwater Fish Directive. Other uses of the site include commercial angling, oyster farming, boating (including dolphin-watching trips) and shooting. Some of these may pose threats to the birds and dolphins through disturbance. Specific threats to the dolphins include underwater acoustic disturbance, entanglement in fishing gear and collisions with fast moving craft.

This site is of great ecological interest as it contains a high number of habitats and species listed on Annexes I and II of the E.U. Habitats Directive, including the priority habitat lagoon, the only known resident population of Bottle-nosed Dolphin in Ireland and all three Irish lamprey species. A good number of Red Data Book species are also present, perhaps most notably the thriving populations of Triangular Club-rush. A number of species listed on Annex I of the E.U. Birds Directive are also present, either wintering or breeding. Indeed, the Shannon and Fergus Estuaries form the largest estuarine complex in Ireland and support more wintering wildfowl and waders than any other site in the country. Most of the estuarine part of the site has been designated a Special Protection Area (SPA), under the E.U. Birds Directive, primarily to protect the large numbers of migratory birds present in winter.

17.05.2005

3.3.2 Lower River Suir SAC (Site Code: 002137) site synopsis (NPWS)

This site consists of the freshwater stretches of the River Suir immediately south of Thurles, the tidal stretches as far as the confluence with the Barrow/Nore immediately east of Cheekpoint in Co. Waterford and many tributaries including the Clodiagh in Co. Waterford, the Lingaun, Anner, Nier, Tar, Aherlow, Multeen and Clodiagh in Co. Tipperary. The Suir and its tributaries flows through the counties of Tipperary, Kilkenny and Waterford. Upstream of Waterford city, the swinging meanders of the Suir crisscross the Devonian sandstone rim of hard rocks no less than three times as they leave the limestone-floored downfold below Carrick In the vicinity of Carrick-on-Suir the river follows the limestone floor of the Carrick Syncline. Upstream of Clonmel the river and its tributaries traverse Upper Palaeozoic Rocks, mainly the Lower Carboniferous Visean and Tournaisian. The freshwater stretches of the Clodiagh River in Co. Waterford traverse Silurian rocks, through narrow bands of Old Red Sandstone and Lower Avonian Shales before reaching the carboniferous limestone close to its confluence with the Suir. The Aherlow River flows through a Carboniferous limestone valley, with outcrops of Old Red Sandstone forming the Galtee Mountains to the south and the Slievenamuck range to the north. Glacial deposits of sands and gravels are common along the valley bottom, flanking the present-day river course.

The site is a candidate SAC selected for the presence of the priority habitats on Annex I of the E.U. Habitats Directive - alluvial wet woodlands and Yew Wood. The site is also selected as *a candidate SAC for floating river vegetation, Atlantic salt meadows, Mediterranean salt meadows, old oak woodlands and eutrophic tall herbs, all habitats listed on Annex I of the E.U. Habitats Directive. The site is also selected for the following species listed on Annex II of the same directive - Sea Lamprey, River Lamprey, Brook Lamprey, Freshwater Pearl Mussel, Crayfish, Twaite Shad, Atlantic Salmon and Otter.*

Alluvial wet woodland is declining habitat in Europe as a result of drainage and reclamation. The best examples of this type of woodland in the site are found on the islands just below Carrick-on-Suir and at Fiddown Island. Species occurring here include Almond Willow (Salix triandra), White Willow (S. alba), Grey Willow (S. cinerea), Osier (S. viminalis), with Iris (Iris pseudacorus), Hemlock Water-dropwort (Oenanthe crocata), Angelica (Angelica sylvestris), Pendulus Sedge (Carex pendula), Meadowsweet (Filipendula ulmaria) and Valerian (Valeriana officinalis). The terrain is littered with dead trunks and branches and intersected with small channels which carry small streams to the river. The bryophyte and lichen floras appear to be rich and require further investigation. A small plot is currently being coppiced and managed by National Parks and Wildlife. In the drier areas the wet woodland species merge with other tree and shrub species including Ash (Fraxinus excelsior), Hazel (Corylus avellana), Hawthorn (Crataegus monogyna) and Blackthorn (Prunus spinosa). This adds further to the ecological interest of this site.

Eutrophic tall herb vegetation occurs in association with the various areas of alluvial forest and elsewhere where the flood-plain of the river is intact. Characteristic species of the habitat include Meadowsweet (Filipendula ulmaria), Purple Loosestrife (Lythrum salicaria), Marsh Ragwort (Senecio aquaticus), Ground Ivy (Glechoma hederacea) and Hedge Bindweed (Calystegia sepium).

Old oak woodlands are also of importance at the site. The best examples are seen in Portlaw Wood which lies on both sides of the Clodiagh River. On the south-facing side the stand is more open and the Oaks (mainly Quercus robur) are well grown and spreading. Ivy (Hedera helix) and Bramble (Rubus fruticosus) are common on the ground, indicating relatively high light conditions. Oak regeneration is dense, varying in age from 0-40 years and Holly (Ilex aquifolium) is fairly common but mostly quite young. Across the valley, by contrast, the trees are much more closely spaced and though taller are poorly grown on average. There are no clearings; large Oaks extend to the boundary wall. In the darker conditions, Ivy is much rarer and Holly much more frequent, forming a closed canopy in places. Oak regeneration is uncommon since there are as yet few natural clearings. The shallowness of the soil on the northfacing slope probably contributes to the poor tree growth there. The acid nature of the substrate has induced a "mountain" type Oakwood community to develop. There is an extensive species list present throughout including an abundance of mosses, liverworts and lichens. The rare lichen Lobaria pulmonaria, an indicator of ancient woodlands, is found.

Inchinsquillib Wood consists of three small separate sloping blocks of woodland in a valley cut by the young Multeen River and its tributaries through acidic Old Red Sandstone, and Silurian rocks. Two blocks, both with an eastern aspect, located to the north of the road, are *predominantly of Sessile oak (Quercus petraea) and Hazel, with Downy Birch (Betula pubescens), Ash and Holly. The ground flora is quite mixed with for example Wood sedge (Carex sylvatica), Bluebell (Hyacinthoides non-scriptus), Primrose (Primula vulgaris), Wood-sorrel (Oxalis acetosella), Pignut (Conopodium majus) and Hard fern (Blechnum spicant). The base poor nature of the underlying rock is, to some extent masked by the overlying drift. The third block, to the south of the road, and with a northern aspect, is a similar although less mature mixture of Sessile Oak, Birch and Holly, the influence of the drift is more marked, with the occurrence of Wood anemone (Anemone nemorosa) amongst the ground flora.*

Floating river vegetation is evident in the freshwater stretches of the River Suir and along many of its tributaries. Typical species found include Canadian Pondweed (Elodea canadensis), Milfoil (Myriophyllum spp.), Fennel Pondweed (Potamogeton pectinatus), Curled Pondweed (P. crispus), Perfoliate Pondweed (P. perfoliatus), Pond Water-crowfoot (Ranunculus peltatus), other Crowfoots (Ranunculus spp.) and the moss Fontinalis antipyretica. At a couple of locations along the river, Oppositeleaved Pondweed (Groenlandia densa) occurs. This species is protected under the Flora (Protection) Order, 1999.

The Aherlow River is fast-flowing and mostly follows a natural unmodified river channel. Submerged vegetation includes the aquatic moss Fontinalis antipyretica and Stream Water-crowfoot (Ranunculus pencillatus), while shallow areas support species such as Reed Canary-grass (Phalaris arundinacea), Brooklime (Veronica beccabunga) and Water Mint (Mentha aquatica). The river bank is fringed in places with Alder (Alnus glutinosa) and Willows (Salix spp.).

The Multeen River is fast flowing, mostly gravel-bottomed and appears to follow a natural unmodified river channel. Water Crowfoots occur in abundance and the aquatic moss Fontinalis antipyretica is also common. In sheltered shallows, species such as Water-cress (Rorippa nasturtium-aquaticum) and Water-starworts (Callitriche spp.) occur. The river channel is fringed for most of its length with Alder, Willow and a narrow strip of marshy vegetation.

Salt meadows occur below Waterford City in old meadows where the embankment is absent, or has been breached, and along the tidal stretches of some of the in-flowing rivers below Little Island. There are very narrow, non-continuous bands of this habitat along both banks. More extensive areas are also seen along the south bank at Ballynakill, the east side of Little Island, and in three large salt meadows between Ballynakill and Cheekpoint. The Atlantic and Mediterranean sub types are generally intermixed. The species list is extensive and includes Red Fescue (Festuca rubra), Oraches (Atriplex spp.), Sea Aster (Aster tripolium), Sea Couch Grass (Elymus pycnanthus), frequent Sea Milkwort (Glaux maritima), occasional Wild Celery (Apium graveolens), Parsley Water-dropwort (Oenanthe lachenalii), English Scurvygrass (Cochlearia anglica) and Sea Arrowgrass (Triglochin maritima). These species are more representative of the Atlantic sub-type of the habitat. Common Cord-grass

(Spartina anglica), is rather frequent along the main channel edge and up the internal channels. The legally protected (Flora (Protection) Order, 1999) Meadow Barley (Hordeum secalinum) grows at the landward transition of the saltmarsh. Sea Rush (Juncus maritimus), an indicator of the Mediterranean salt meadows, also occurs.

Other habitats at the site include wet and dry grassland, marsh, reed swamp, improved grassland, coniferous plantations, deciduous woodland, scrub, tidal river, stony shore and mudflats. The most dominant habitat adjoining the river is improved grassland, although there are wet fields with species such as Yellow Flag (Iris pseudacorus), Meadow Sweet (Filipendula ulmaria), Rushes (Juncus spp.), Meadow Buttercup (Ranunculus acris) and Cuckoo Flower (Cardamine pratensis).

Cabragh marshes, just below Thurles, lie in a low-lying tributary valley into which the main river floods in winter. Here there is an extensive area of Common Reed (Phragmites australis) with associated marshland and peaty fen. The transition between vegetation types is often well displayed. A number of wetland plants of interest occur, in particular the Narrow-leaved Bulrush (Typha angustifolia), Bottle Sedge (Carex rostrata) and Blunt-flowered Rush (Juncus subnodulosus). The marsh is naturally eutrophic but it has also the nutritional legacy of the former sugar factory which discharged into it through a number of holding lagoons, now removed. Production is high which is seen in the size of such species as Celery-leaved Buttercup (Ranunculus sceleratus) as well as in the reeds themselves.

Throughout the Lower River Suir site are small areas of woodland other than those described above. These tend to be a mixture of native and non-native species, although there are some areas of semi-natural wet woodland with species such as Ash and Willow. Cahir Park Woodlands is a narrow tract of mixed deciduous woodland lying on the flatlying floodplain of the River Suir. This estate woodland was planted over one hundred years ago and it contains a large component of exotic tree species. However, due to original planting and natural regeneration there is now a good mix of native and exotic species. About 5km north west of Cashel, Ardmayle pond is a long, possibly artificial water body running parallel to the River Suir. It is partly shaded by planted Lime (Tilia hybrids), Sycamore (Acer pseudoplatanus) and the native Alder. Growing beneath the trees are shade tolerant species such as Remote sedge (Carex remota).

The site is of particular conservation interest for the presence of a number of Annex II animal species, including Freshwater Pearl Mussel (Margaritifera margaritifera and M. m. durrovensis), Freshwater Crayfish (Austropotamobius pallipes), Salmon (Salmo salar), Twaite Shad (Alosa fallax fallax), three species of Lampreys - Sea Lamprey (Petromyzon marinus), Brook Lamprey (Lampetra planeri) and River Lamprey (Lampetra fluviatilis) and Otter (Lutra lutra). This is one of only three known spawning grounds in the country for Twaite Shad.

The site also supports populations of several other animal species. Those which are listed in the Irish Red Data Book include Daubenton's Bat (Myotis daubentoni), Nattererer's Bat (M.

nattereri), Pipistrelle (Pipistrellus pipistrellus), Pine Marten (Martes martes), Badger (Meles meles), the Irish Hare (Lepus timidus hibernicus), Smelt (Osmerus eperlanus) and the Frog (Rana temporaria). Breeding stocks of Carp are found in Kilsheelan Lake. This is one of only two lakes in the country which is known to have supported breeding Carp. Carp require unusually high summer water temperatures to breed in Ireland and the site may therefore support interesting invertebrate populations.

Parts of the cSAC site have also been identified as of ornithological importance for a number of Annex I (EU Birds Directive) bird species, including Greenland White-fronted Goose (10), Golden Plover (1490), Whooper Swan (7) and Kingfisher. Figures given in brackets are the average maximum counts from 4 count areas within the site for the three winters between 1994 and 1997. Wintering populations of migratory birds use the site. Flocks are seen in Coolfinn Marsh and also along the reedbeds and saltmarsh areas of the Suir. Coolfinn supports nationally important numbers of Greylag Geese on a regular basis. Numbers between 600 and 700 are recorded. Other species occurring include Mallard (21), Teal (159), Wigeon (26), Tufted Duck (60), Pintail (4), Pochard (2), Little Grebe (2), Black-tailed Godwit (20), Oystercatcher (16), Lapwing (993), Dunlin (101), Curlew (195), Redshank (28), Greenshank (4) and Green Sandpiper (1). Nationally important numbers of Lapwing (2750) were recorded at Faithlegg in the winter of 1996/97. In Cabragh marshes there is abundant food for surface feeding wildfowl which total at 1,000 or so in winter. Widgeon, Teal and Mallard are numerous and the latter has a large breeding population - with up to 400 in summer. In addition, less frequent species like Shoveler and Pintail occur and there are records for both Whooper and Bewick's swans. Kingfisher, a species that is listed on Annex I of the EU Birds Directive, occurs along some of the many tributaries throughout the site.

Landuse at the site consists mainly of agricultural activities including grazing, silage production, fertilising and land reclamation. The grassland is intensively managed and the rivers are therefore vulnerable to pollution from run-off of fertilisers and slurry. Arable crops are also grown. Fishing is a main tourist attraction on stretches of the Suir and some of its tributaries and there are a number of Angler Associations, some with a number of beats. Fishing stands and styles have been erected in places. Both commercial and leisure fishing takes place on the rivers. The Aherlow River is a designated Salmonid Water under the EU Freshwater Fish Directive. Other recreational activities such as boating, golfing and walking are also popular. Several industrial developments, which discharge into the river, border the site including three dairy related operations and a tannery.

The Lower River Suir contains excellent examples of a number of Annex I habitats, including the priority habitat Alluvial Forest. The site also supports populations of several Annex II animal species and a number of Red Data Book animal species. The presence of two legally protected plants (Flora (Protection) Order, 1999) and the ornithological importance of the river adds further to the ecological interest of this site.

6.10.2006

3.3.3 Slievefelim to Silvermines Mountains SPA (004165)

The Slievefelim to Silvermines Mountains SPA is an extensive upland site located in Counties Tipperary and Limerick. Much of the site is over 200 m in altitude and rises to 694 m at Keeper Hill. Other peaks included in the site are Slieve Felim, Knockstanna, Knockappul, Mother Mountain, Knockteige, Cooneen Hill and Silvermine Mountain. The site is underlain mainly by sandstones of Silurian age. Several important rivers rise within the site, including the Mulkear, Bilboa and Clare. The site consists of a variety of upland habitats, though approximately half is afforested. The coniferous forests include first and second rotation plantations, with both pre-thicket and post-thicket stands present. Substantial areas of clear-fell are also present at any one time. The principal tree species present are Sitka Spruce (Picea sitchensis) and Lodgepole Pine (Pinus contorta). Roughly one-quarter of the site is unplanted blanket bog and heath, with both wet and dry heath present. The bog and heath vegetation includes such typical species as Ling Heather (Calluna vulgaris), Bilberry (Vaccinium myrtillus), Bell Heather (Erica cinerea), Common Cottongrass (Eriophorum angustifolium), Hare's-tail Cottongrass (Eriophorum vaginatum), Deergrass (Scirpus cespitosus) and Purple Moorgrass (Molinia caerulea). The remainder of the site is mostly rough grassland that is used for hill farming. This varies in composition and includes some wet areas with rushes (Juncus spp.) and some areas subject to scrub encroachment. Some stands of deciduous woodland also occur, especially within the river valleys.

The site is a Special Protection Area (SPA) under the E.U. Birds Directive, of special conservation interest for Hen Harrier. This SPA is one of the strongholds for Hen Harrier in the country. A survey in 2005 resulted in four confirmed and one possible breeding pairs, whereas nine pairs had been recorded in the 1998-2000 period. These numbers represent 3% of the national total. The mix of forestry and open areas provides optimum habitat conditions for this rare bird, which is listed on Annex I of the Birds Directive. The early stages of new and second-rotation conifer plantations are the most frequently used nesting sites, though some pairs may still nest in tall heather of unplanted bogs and heath. Hen Harriers will forage up to c. 5 km from the nest site, utilising open bog and moorland, young conifer plantations and hill farmland that is not too rank. Birds will often forage in openings and gaps within forests. In Ireland, small birds and small mammals appear to be the most frequently taken prey. The site is also a traditional breeding site for a pair of Peregrine. Merlin has been recorded within the site but further survey is required to determine its status. Both of these species are also listed on Annex I of the E.U. Birds Directive. Red Grouse is found on some of the unplanted areas of bog and heath – this is a species that has declined in Ireland and is now Red-listed.

The main threat to the long-term survival of Hen Harriers within the site is further afforestation, which would reduce and fragment the area of foraging habitat, resulting in possible reductions in breeding density and productivity. Overall, the site provides excellent nesting and foraging habitat for breeding Hen Harrier and is among the top five sites in the country for the species

16.7.2007

3.3.4 Features of Interest of the Lower River Shannon cSAC

Table 11 below lists the Annex I habitats and Annex II species for which the Lower River Shannon cSAC has been selected.

TABLE 11: LIST OF QUALIFYING FEATURES OF INTEREST OF THE LOWER RIVER SHANNON CSAC.

Qualifying Interests of the Lower River Shannon cSAC (Site Code: 002165)
Habitats
Sandbanks which are slightly covered by sea water all the time [1110]
Estuaries [1130]
Mudflats and sandflats not covered by seawater at low tide [1140]
Coastal lagoons [1150]
Large shallow inlets and bays [1160]
Reefs [1170]
Perennial vegetation of stony banks [1220]
Vegetated sea cliffs of the Atlantic and Baltic coasts [1230]
Salicornia and other annuals colonizing mud and sand [1310]
Spartina swards (*Spartinion maritimae*) [1320]
Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330]
Mediterranean salt meadows (*Juncetalia maritimi*) [1410]
Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation [3260]
Molinia meadows on calcareous, peaty or clavey-silt-laden soils (*Molinion caeruleae*) [6410]
Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*) [91E0]
Species
Freshwater pearl mussel (*Margaritifera margaritifera*) [1029]
Sea lamprey (*Petromyzon marinus*) [1095]
Brook lamprey (*Lampetra planeri*) [1096]
River lamprey (*Lampetra fluviatilis*) [1099]
Salmon (*Salmo salar*) [1106]
Bottle-nosed dolphin (*Tursiops truncatus*) [1349]
Otter (*Lutra lutra*) [1355]

3.3.5 Features of Interest of the Lower River Suir SAC.

Table 12, below, lists the Annex I habitats and Annex II species for which the Lower River Suir cSAC has been selected.

TABLE 12: LIST OF QUALIFYING FEATURES OF INTEREST FOR THE LOWER RIVER SUIR CSAC.

Qualifying Interests of the Lower River Suir cSAC (Site Code: 002165) **Habitats**
Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330]
Mediterranean salt meadows (*Juncetalia maritimi*) [1410]
Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation [3260]
Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels [6430]
Old sessile oak woods with *Ilex* and Blechnum in British Isles [91A0]
Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*) [91E0]
Taxus baccata woods of the British Isles [91J0]
Species
Freshwater pearl mussel (*Margaritifera margaritifera*) [1029]
White-clawed crayfish (*Austropotamobius pallipes*) [1092]
Sea lamprey (*Petromyzon* marinus) [1095]
Brook lamprey (*Lampetra planeri*) [1096]
River lamprey (*Lampetra fluviatilis*) [1099]
Allis shad (*Alosa alosa*) [1102]
Twaite shad (*Alosa fallax fallax*) [1103]
Salmon (*Salmo salar*) [1106]
Otter (*Lutra lutra*) [1355]

3.3.1 Feature of Interest of the Slievefelim to Silvermines Mountains SPA (004165).

Table 13, below, lists the bird species for which the Slievefelim to Silvermines Mountains SPA (004165) has been selected.

TABLE 13: LIST OF QUALIFYING FEATURES OF INTEREST OF THE SLIEVEFELIM TO SILVERMINES MOUNTAINS SPA.

Qualifying Interests of the Slievefelim to Silvermines Mountains SPA Site Code:(004165)
Hen Harrier (*C. cyaneus*) [A082]

3.4 CONSERVATION STATUS

According to the Habitat's Directive, the conservation status of a natural habitat will be taken as 'favourable' when:

• its natural range and the area it covers within that range are stable or increasing,

• the specific structure and functions which are necessary for its long-term maintenance exist are likely to continue to exist for the foreseeable future, and

• the conservation status of its typical species is favourable as defined below.

According to the Habitat's Directive, the conservation status of a species means the sum of the influences acting on the species concerned that may affect the long-term distribution and abundance of its populations. The conservation status will be taken as 'favourable' when:

• population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats,

• the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and

• there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

3.4.1 Conservation Objectives and Management Plans

There are no management plans completed to date for the Lower River Shannon cSAC, Lower River Suir cSAC or the Silvermines Mountains SPA. The conservation objectives for the Natura 2000 Sites are as follows:

3.4.1.1 Lower River Shannon cSAC (site code: 002165):

Objective: To maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species for which the SAC has been selected:

- [1029] *Margaritifera margaritifera*
- [1095] *Petromyzon marinus*
- [1096] *Lampetra planeri*
- [1099] *Lampetra fluviatilis*
- [1106] *Salmo salar* (only in fresh water)
- [1110] Sandbanks which are slightly covered by sea water all the time
- [1130] Estuaries
- [1140] Mudflats and sandflats not covered by seawater at low tide
- [1150] Coastal lagoons

- [1160] Large shallow inlets and bays
- [1170] Reefs
- [1220] Perennial vegetation of stony banks
- [1230] Vegetated sea cliffs of the Atlantic and Baltic coasts
- [1310] *Salicornia* and other annuals colonizing mud and sand
- [1330] Atlantic salt meadows (*Glauco□Puccinellietalia* maritimae)
- [1349] *Tursiops truncatus*
- [1355] *Lutra lutra*
- [1410] Mediterranean salt meadows (*Juncetalia* maritimi)
- [3260]Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho□Batrachion* vegetation [3260]
- [6410] *Molinia* meadows on calcareous, peaty or clayey□silt□laden soils (*Molinion caeruleae*)
- [91E0] Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno□Padion*, *Alnion incanae*, *Salicion albae*)

3.4.1.2 Lower River Suir cSAC (site code: 002137)

Objective: To maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species for which the SAC has been selected:

- [1029] *Margaritifera margaritifera*
- [1092] *Austropotamobius pallipes*
- [1095] *Petromyzon marinus*
- [1096] *Lampetra planeri*
- [1099] *Lampetra fluviatilis*
- [1103] *Alosa fallax*
- [1106] *Salmo salar* (only in fresh water)
- [1330] Atlantic salt meadows (*Glauco□Puccinellietalia* maritimae)
- [1355] *Lutra lutra*
- [1410] Mediterranean salt meadows (*Juncetalia maritimi*)
- [3260]Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho□Batrachion* vegetation
- [6430] Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels
- [91A0] Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles
- [91E0] Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno□Padion*, *Alnion incanae*, *Salicion albae*)
- [91J0] *Taxus baccata* woods of the British Isles

3.4.1.3 Slievefelim to Silvermines Mountains SPA (site code: 004165):

Objective: To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA:

- *Circus cyaneus* [breeding]

3.4.2 Conclusion

Any impact which is likely to cause or contribute to any of the qualifying species and habitats not reaching or maintaining favourable conservation status within these Natura 2000 Sites would be regarded as being in conflict with the management of the sites. In addition, any impact which would hinder the maintenance of the extent, species richness and biodiversity of the sites would also be in conflict with the conservation objectives.

3.5 ECOLOGICAL FEATURES SELECTED FOR NATURA IMPACT ASSESSMENT

Tables 11, 12 and 13 above, list the habitats and species for which the Natura 2000 sites, considered in this section of the document, have been designated. It is considered that some of these features will not be impacted by the proposed development and these are listed below in Table 13 with the Natura 2000 sites designated for their protection, in section 3.5.1 below. The significance of the impacts affecting the remaining habitats and species, listed in section 3.5.2, below, will then be assessed in terms of magnitude/extent, probability and duration in sections following.

3.5.1 Ecological features not selected for Natura Impact Assessment

The species and habitats of qualifying interest that will not be impacted by the proposed development are listed in Table 14. These habitats,which are either coastal in their distribution or are grassland and forest habitats not connected to the proposal site either directly within the footprint of the development or via waterways draining the site. Dolphin is a marine species and therefore not present within the zone of impact influence of the proposed windfarm site.

TABLE 14: LIST OF ECOLOGICAL FEATURES NOT SELECTED FOR NATURA IMPACT ASSESSMENT WITH NATURA 2000 SITE DESIGNATED FOR THEIR PROTECTION

Feature	Designated Site
Coastal and Halophytic Habitats	
Sandbanks which are slightly covered by sea water all the time [1110]	Lower River Shannon cSAC
Estuaries [1130]	Lower River Shannon cSAC
Mudflats and sandflats not covered by seawater at low tide [1140]	Lower River Shannon cSAC
Coastal lagoons [1150]	Lower River Shannon cSAC

Large shallow inlets and bays [1160]	Lower River Shannon cSAC
Reefs [1170]	Lower River Shannon cSAC
Perennial vegetation of stony banks [1220]	Lower River Shannon cSAC
Vegetated sea cliffs of the Atlantic and Baltic coasts [1230]	Lower River Shannon cSAC
Salicornia and other annuals colonizing mud and sand [1310]	Lower River Shannon cSAC
Spartina swards (*Spartinion maritimae*) [1320]	Lower River Shannon cSAC
Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330]	Lower River Shannon cSAC, Lower River Suir cSAC
Mediterranean salt meadows (*Juncetalia maritimi*) [1410]	Lower River Shannon cSAC, Lower River Suir cSAC
Natural and Semi-natural grassland Habitats	
Molinia meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*) [6410]	Lower River Shannon cSAC
Forest Habitats	
Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) [91E0]	Lower River Shannon cSAC, Lower River Suir cSAC
Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels [6430]	Lower River Suir cSAC
Old sessile oak woods with Ilex and Blechnum in British Isles [91A0]	Lower River Suir cSAC
Taxus baccata woods of the British Isles [91J0]	Lower River Suir cSAC
Species (Marine)	
Bottlenose dolphin (*T. truncatus*) [1349]	Lower River Shannon cSAC

3.5.2 *Ecological features selected for Appropriate Assessment*

All of the features of qualifying interest that were deemed relevant to the proposed development were selected for further analysis in respect to likely impacts. These features are listed in Table 15, below. Characteristics of the ecological features selected for Appropriate Assessment are then discussed in the sections following.

TABLE 15: ECOLOGICAL FEATURES SELECTED FOR NATURA IMPACT ASSESSMENT WITHIN NATURA 2000 SITES DESIGNATED FOR THEIR PROTECTION

Feature	Designated Site
Freshwater Habitats (Aquatic)	
Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation [3260]	Lower River Shannon cSAC, Lower River Suir cSAC
Birds	

Hen Harrier (*C. cyaneus*) [A082]	Slievefelim to Silvermines Mountains SPA
Invertebrates	
Freshwater pearl mussel (*M. margaritifera*) [1029]	Lower River Shannon cSAC, Lower River Suir cSAC
White-clawed crayfish (*A. pallipes*) [1092]	Lower River Suir cSAC
Fishes	
Salmon (*S. salar*) [1106]	Lower River Shannon cSAC, Lower River Suir cSAC
Sea lamprey (*P. marinus*) [1095]	Lower River Shannon cSAC, Lower River Suir cSAC
Brook lamprey (*L. planeri*) [1096]	Lower River Shannon cSAC, Lower River Suir cSAC
River lamprey (*L. fluviatilis*) [1099]	Lower River Shannon cSAC, Lower River Suir cSAC
Allis shad (*A. alosa*) [1102]	Lower River Suir cSAC
Twaite shad (*A. fallax fallax*) [1103]	Lower River Suir cSAC
Mammals	
Otter (*L. lutra*) [1355]	Lower River Shannon cSAC, Lower River Suir cSAC

3.5.2.1 Habitat

Both the Lower River Shannon cSAC and the Lower River Suir cSAC are designated for the protection of the habitat type ‘Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation [3260]’. This is a freshwater habitat found in sections of water courses with natural or semi-natural dynamics (minor, average and major beds) where the water quality shows no significant deterioration (EDG, 2007). This habitat is described as being present ‘in the major river systems within’ the Lower River Shannon cSAC (see Section 3.3.1, Site synopsis 002165), and is ‘present in the freshwater stretches of the River Suir and along many of its tributaries’ (See Section 3.3.2, site synopsis 002137) Because floating river vegetation communities are found along some the freshwater stretches within both Natura 2000 sites there is the potential that this habitat is within the zone of impact influence of the proposal. The primary pressures on this habitat are considered to be eutrophication, overgrazing, excessive fertilisation, afforestation and the introduction of invasive alien species;the current conservation status of this habitat type is bad (NPWS, 2008). Any impact on this habitat would occur as a result of unmitigated adverse water quality impacts caused by the proposal described in this report. These impacts are discussed in section 3.6.3 below.

3.5.2.2 Birds

Hen Harrier (*C. cyaneus*) [A082]

The hen harrier is listed as an Annex I species under the Birds Directive and classified as an 'Amber Listed' species of medium conservation concern (see Lynas *et al*. 2007). Breeding birds are confined to moorland and young forestry plantations, where they nest on the ground. Hen harriers are found mainly in Counties Laois, Tipperary, Cork, Clare, Limerick and Kerry. In summer hen harrier are found on mountains and moorlands, nesting on the ground. It also nests in young conifer plantations. In winter birds can roost communally and are found in most parts of Ireland including coastal areas.

There is a clear association between habitat composition and hen harrier activity (Wilson *et al.* 2006) and both the quality and quantity of foraging habitats are known to influence hen harrier distribution (Watson, 1977, Pain et al., 1997, Redpath & Thirgood, 1999, Redpath et al., 2002, Madders 2003 cited in Ruddock *et al*. 2012). In their analysis of the distribution of hen harriers in Ireland Wilson *et al.* (2006) determined that areas with less than 30% cover of bog, rough pasture or young forest were avoided by hen harriers. Therefore, the habitat composition of the area is a determining factor influencing the potential level of hen harrier activity. An additional, and primary, governing factor is the proximity of hen harrier nests, as this has a major influence on habitat use (Madders, 2000), both by breeding birds and fledging juveniles, within the areas adjacent to any location.

Therefore, an extensive area of habitats, which are of high ecological value to hen harrier, is available in the extended geographical area surrounding the proposed Upperchurch Windfarm site. It is considered that hen harriers species will preferentially select these areas of high ecological value above the, lower value, post thicket canopy conifer and agricultural grassland habitats or the remnant upland blanket bog/wet heath mosaic areas that are available within the windfarm site.

Post thicket conifer plantation is of only limited value to hen harrier (O'Flynn 1983, Sim et al. 2001 cited in Wilson *et al*., 2009) and is not strongly associated with either foraging or breeding (Madders 2003, Barton *et al*. 2006 cited in Wilson *et al.* 2009) possibly because of the lack of structural diversity within the uniform conifer blocks (O'Donoghue et al. 2011).

It is noted that hen harriers in Ireland strongly avoid this habitat type for nesting due to the lack of cover and the levels of human activity (Wilson *et al*., 2009).

There is a strong association in Ireland between, pre thicket, second rotation conifer plantation and hen harrier nest site selection (Norriss *et al*. 2002, O'Donoghue 2004 cited in Wilson *et al*. 2009; Irwin *et al*. 2012) albeit that other factors, such as the remaining area of heath/bog and rough grassland that is available for foraging (Norris *et al*. 2007, cited in Lewis *et al*. 2009) also influence site selection.. Young second rotation conifer are of value to nesting and foraging hen harrier after 4 years and were replanting to take place in 2035 then the habitat could be conceivable of value for 1-6 years during the later years of windfarm operation.

3.5.2.3 Aquatic species

Freshwater pearl mussel (*M. margaritifera*) [1029]

The freshwater pearl mussel is listed under Annex II of the EU Habitats Directive and is one of the species for which the Lower River Shannon cSAC and the Lower River Suir cSAC have been designated. Ireland is said to support up to 46% of the known populations of the freshwater pearl mussel (*M. margaritifera*) within the European Union (Anon, 2010). The freshwater pearl mussel is listed under Annex II of the EU Habitats Directive and is one of the species for which both the Lower River Shannon cSAC, Lower River Suir cSAC have been designated. Freshwater pearl mussels have a complex life cycle. They mature between seven and 15 years of age and can have a prolonged fertile period lasting into old age. The larvae (glochidia) initially attach to the gills of salmonid fish hosts which provide nourishment, before they become large enough for independent development in the river bed. After excysting from host fish juvenile mussels survive in the interstices of the substrate, comprised of a stable combination of sand, gravels and cobbles, where good oxygen exchange occurs. A covering of fine silt may prevent this and cause heavy mortalities. In summary, the freshwater pearl mussel requires very high quality rivers with clean river beds and waters with very low levels of nutrients without artificially elevated levels of siltation. The survival of the freshwater pearl mussel is under threat and many of the populations are not reproducing and will ultimately disappear if rehabilitative action is not taken.

Of the remaining populations in Ireland it is estimated that at least 90% will “probably never breed successfully again” (Moorkens, 2006, cited in Byrne et al., 2009).

The principal threat to this species is poor substrate quality due to increased growth of algal and macrophyte vegetation as a result of severe nutrient enrichment, as well as physical siltation.. Freshwater pearl mussel is listed as critically endangered in the Republic of Ireland in the most recent review of local IUCN threat status of Irish molluscs. Its overall conservation status in Ireland is ‘Unfavourable’ (NPWS, 2008)

The published current distribution for this species[4] does not include either of the 10km squares which incorporate the location of the proposal considered in this document namely R95 and R96.

White-clawed crayfish (*A. pallipes*) [1092]

[4] Species distribution mapping referred to in this section of the document is published in NPWS, 2008

The Lower River Suir cSAC is designated for the protection of this species. In Ireland, the white-clawed crayfish most commonly occurs in small and medium-sized lakes, large rivers, streams and drains, wherever there is sufficient lime (Reynolds, 2007). The species prefers relatively cool temperatures and adequate dissolved oxygen and lime, although it is capable of tolerating significant fluctuations. Juveniles live among submerged tree-roots, gravel or aquatic plants, while larger crayfish need stones to hide under, or earthen banks in which to burrow. Crayfish show little activity during the winter period (December to March), spending most of their time torpid in refuges. They become more active when the water temperature increases. Females carry their eggs over winter attached in a dense cluster under their tails (Peay, 2003) and they require undisturbed shelter over a prolonged winter-spring period.

White-clawed crayfish eat a wide range of food including fallen leaves, aquatic vegetation, dead fish, aquatic invertebrates such as snails and caddis-fly larvae, and other dead or live crayfish. They have a wide range of predators; juveniles are eaten by fish, birds and invertebrate predators, adults are taken by large predators; heron, otter and mink. The crayfish try to avoid predation by hiding in refuges by day and coming out at night, when most birds and fish are resting.

The overall conservation status of the white-clawed crayfish in Ireland is poor, due to the reduction in its range and the continuing pressures that it faces (NPWS, 2008). The most recently published Current Range and Current Distribution mapping for this species includes both 10km grid squares which incorporate the proposal considered in this document.

Salmon (*S. salar*) [1106]

Atlantic salmon is a species of qualifying interest for both the Lower River Shannon cSAC, Lower River Suir cSAC .It is an anadromous species, living in freshwater for at least the first 2 or 3 years of life before migrating to sea. Relatively large cool rivers with extensive gravelly bottom headwaters are essential during their early life. Smolts migrate to sea where they may live for 1 or 2 years before returning to freshwater. A decline in Salmon stocks is well recognised in Ireland and throughout the range of the North Atlantic Salmon and is attributed to several factors including the salmon disease Ulcerative Dermal Necrosis (UDN), poor marine survival and some overfishing. The NPWS suggest that agricultural enrichment, forestry related pressures and poor water quality resulting from inadequate sewage treatment are the major pressures affecting Irish salmon rivers (NPWS 2007).

The most recently published Current Range and Current Distribution mapping for this species includes the 10km grid squares that encompass the location of the proposal considered in this document, and indicates that the species has a wide distribution within the River Suir system ranging from the headwaters to the lower reaches of the system and and also within the extended Mulkear River system, which is a tributary of the Shannon, to which first order streams adjacent to the site drain.

Sea lamprey (*P. marinus*) [1095]

Both the Lower River Shannon cSAC and the Lower River Suir cSAC are designated for the protection of this species. Sea lampreys spend their adult life in marine and estuarine waters, living as external parasites on other fish species. They migrate up rivers to spawn in areas of clean gravels and after they have spawned, they die. After hatching, the young larvae settle in areas of fine sediment in still water, where they burrow. They live as filter feeders and may remain in fine sediments for several years before transforming into adult fish. Sea lampreys, which can grow up to 1m in length, are widely distributed around the coast. However they tend to occur in low densities. Overall, the conservation status of the sea lamprey in Ireland is considered to be poor (NPWS, 2008). The Current Range and Current Distribution mapping does not include the 10km squares which encompass the proposal considered in this document

Brook lamprey (*L. planeri*) [1096] River lamprey (*L. fluviatilis*) [1099]

The river lamprey grows to 30cm and has a similar life history to the sea lamprey. The brook lamprey is the smallest of the three lampreys native to Ireland at 15 to 20cm. It is also the only one of the three which is non-parasitic and spends all its life in freshwater. Despite the difference in ecology, brook and river lamprey are very similar genetically and extremely difficult to distinguish from each other. Juvenile river and brook lampreys cannot be discriminated and metamorphosed individuals can only be distinguished on the basis of dentition (King *et al.*, 2004). As a result, for the purposes of this assessment, the brook and river lampreys have been treated together. Both are species of qualifying interest for both the Lower River Shannon cSAC and the Lower River Suir cSAC. The current conservation status of these species in Ireland is considered to be good (NPWS, 2008).

Allis shad (*A. alosa*) [1102]

Allis shad spend their adult life at sea or in the lower reaches of estuaries, ascending to freshwater to spawn in early summer. The spawning females shed their eggs into the water where they either drop into the gravel bed or begin to drift downstream. Those eggs that fall into gravels hatch after several days and then drift downstream. The young fish may remain in estuarine waters during their second year before finally going to sea where they mature. While European populations have a recorded capacity for significant migration upstream, this capacity seems more constrained in Irish populations (King *et al.*, 2004). Weirs and dams are known to be obstacles to the migration of Allis shad upstream. The current conservation status of the species is ‘Unknown’ (NPWS, 2008).

Twaite shad (*A. fallax* fallax) [1103]

The twaite shad is a member of the herring family and is found in coastal areas from Norway and Iceland to the north-eastern Mediterranean. Shad normally live in estuarine and coastal waters but come into the lower reaches of rivers to spawn. Very little is known about the distribution, abundance and biology of the twaite shad although it has been studied in the

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River Barrow in County Waterford, and in the Solway rivers (Scotland)[5]. Twaite shad normally spawn,in May and June , near the tidal limits (NPWS, 2008). Weirs and dams are known to be obstacles to the migration of Twaite shad upstream. The current conservation status of the species is bad (NPWS, 2008).). Irish Red Data Book classified as vulnerable.

3.5.2.4 Mammals

Otter (*L. lutra*) [1355]

The otter is a species of qualifying interest for both the Lower River Shannon cSAC and Lower River Suir cSAC. The otter is widespread throughout the country, in freshwater and coastal habitats, and Ireland has long been considered to hold one of the most important otter populations in Western Europe (Whilde, 1993). Due to a decline in the population in Europe, including Ireland, the otter has been listed in Annex II of the EU Habitats Directive and Appendix II of the Berne Convention. It is also protected under the Wildlife Acts 1976 and 2000. It is listed in the Red Data Book (Whilde, 1993) as vulnerable.

Otters can, potentially, exploit all stretches of a river system where they are present. The two major threats facing otters in Europe are habitat destruction and water pollution (from NPWS, 2008) and the current conservation status for the species is considered ‘Unfavourable-Inadequate’ (NPWS, 2008). In an Irish context the main four threats have been assessed to be direct and indirect habitat destruction, pollution (particularly organic pollution resulting in fish kills), disturbance from increasing recreational activities and accidental death and persecution (Foster-Turley, *et al.*, 1990).

[5] http://www.habitas.org.uk/priority/species.asp?item=42767

3.6 ASSESSMENT OF POTENTIAL IMPACTS

3.6.1 Habitat loss or alteration

3.6.1.1 habitats

The proposal considered in this document does not require any land take from any Natura 2000 or Ramsar site. It is considered that no significant habitat loss or alteration impacts, within any of the designated sites considered in this section of the document, are reasonably foreseeable as a result of the proposal considered in this document.

3.6.1.2 Aquatic habitats

The potential for the alteration of aquatic habitats due to an impairment of water quality is assessed section 3.6.3 below.

3.6.2 Disturbance and/or displacement of species

3.6.2.1 Birds

In relation to the Natura 2000 sites and their conservation objectives, the main bird species of concern is the hen harrier as this is the species for which the Slievefelim to Silvermines Mountains SPA is designated. The bird surveys of the Upperchurch area show that the proposed development site is not greatly or regularly utilised by hen harriers. Hen harriers which use the wider district for foraging could be affected by:

- construction activities;
- disturbance/displacement by the actual presence of the turbines; and
- risk of collision.

It is possible that the construction activities (construction vehicles, erection of turbines, construction of access roads, turbine foundations and hardstandings *etc.*) could cause disturbance to foraging and/or potential nesting hen harriers in the area. However, the bird surveys show that no breeding took place within the study area in 2011. Hence, the construction activities at the proposed development site are unlikely to impact breeding hen harriers.

<u>Disturbance/displacement by the presence of the turbines</u>

Recent research shows that operational turbines cause low levels of displacement of foraging hen harriers. A monitoring study on hen harriers at an existing windfarm in Derrybrien, Co. Galway indicates that the displacement of hen harriers due to wind turbines is also relatively low, with foraging hen harriers regularly observed within 50m of turbines (Madden and Porter, 2007).

Displacement in terms of nesting/breeding appears to be greater. Whitfield and Madders (2006) refer to Natural Research unpublished data from Argyll in Scotland and Northern Ireland, which indicate that nesting attempts may occur in the order of 200-300m around turbines. More recent research indicates that there is a lower density of breeding hen harriers within 500m of turbines (Pearce-Higgins *et al.*, 2009).

Hen harrier was observed on two occasions at Upperchurch during the course of the winter and summer raptor vantage point surveys. The randomness and low number of hen harrier observations during the vantage point surveys in 2010 and 2011 suggests that the proposed windfarm site 2km west of Upperchurch is used infrequently by hen harriers. The very low number of observations would suggest that the significance of the risk of Disturbance/displacement as a result of the construction of the wind farm is considered *very low*.

Collision risk

Collision risk for hen harriers is considered to be low (see Madden and Porter, 2007; Whitfield and Madders, 2006). They are known to be manoeuvrable in flight and have been observed to fly to within 10m of turbine bases (Madden and Porter, 2007) and to fly through the gaps in an electricity pylon. The minimum distance between the proposed turbine hubs within the proposed development site is 379m. The randomness and low number of hen harrier observations during the vantage point surveys in 2010 and 2011 suggests that the proposed windfarm site 2km west of Upperchurch is used infrequently by hen harriers and the resultant risk of collision is *very low*.

3.6.2.2 Aquatic species

Freshwater pearl mussel (Margaritifera margaritifera)

Distribution in the Lower River Shannon cSAC

As was noted previously the current published distribution for this species within the Shannon river system does not include any 10km square which incorporates any stretch of river downstream of the location of the proposal considered in this document. Mapping of the distribution in this cSAC indicates that the species is restricted to the Feale system a separate tributary which drains to the Shannon Estuary via the Cashen River in North County Kerry. No records for the river system downstream of the proposal site are retained at the NBDC on line data resource. On the basis of the evidence outlined in this paragraph it is concluded that no impacts on this species, within the Lower River Shannon cSAC downstream of the proposal site, are reasonably foreseeable as a result of the proposal considered in this document.

Distribution in the Lower River Suir cSAC

The published current distribution for this species includes 10km grid squares R94 and S05 which incorporate the Clodiagh River into which first order stream adjacent to the proposal site drain. The distribution mapping also includes 10km grid squares S04, S02 and S01 which contain a significant stretch of the main channel of the Suir further downstream of the proposal site. In addition records from 2006, retained at the National Biodiversity Data Centre on line data resource, indicate that the species was then recorded in several locations on the Multeen River. An unnamed stream adjacent to the proposal site drains to the Turaheen River which in turn drains to the Multeen. The nearest record retained is for 1km grid square R9844 situated approximately 21km downstream[6] of the proposal site. It is presumed in light of the aforementioned direct evidence and on the basis of the precautionary principle, that this species is potentially present within the zone of impact influence of the proposal.

There is a risk that the water quality of the local watercourses, that drain the site, could be impaired during the construction stage of the proposed windfarm. It is possible that this could impact negatively on the Freshwater pearl mussel within the Lower River Suir cSAC downstream of the proposal site.

There is also a risk of negative impact to this species because of its complex life cycle which includes a larval stage when they are dependent on salmonid fish hosts. It is possible that these salmonids could be in the impact zone of the development when they migrate further upstream. The main potential risk to the mussel posed by the proposed development is the threat of sedimentation and pollution of waterways during the construction phase of the proposal. Therefore, it cannot be objectively concluded that significant indirect impacts on the freshwater pearl mussel will not ensue from an unmitigated construction phase.

White-clawed crayfish (Austropotamobius pallipes)

As was noted previously the most recently published Current Range and Current Distribution mapping for this species includes both 10km grid squares which incorporate the proposal considered in this document. In addition, records retained at the NBDC include one location within the Turraheen system and several locations on the Owenbeg system all of which are downstream of the proposal site considered in this document. The record on the Turraheen is located approximately 8km[7] downstream of the site. The nearest location on the Owenbeg is approximately 4km downstream of the site. O Connor (2007) noted that crayfish were

[6] Distance measured on 'Draw and Measure' tool on the IFI Water Framework Directive Fish Survey Map Viewer (Available at http://www.ifigis.ie/WFDFishMap/ [accessed 14/08/2012])

[7] Distances measured on 'Analysis' tool on the NBDC Biodiversity Maps Map Viewer. (Available at http://maps.biodiversityireland.ie/#/Map [accessed 15/08/2012])

abundant at Munroe Bridge which is situated on the Cromoge River which drains to Clodiagh at a point upstream of the point of confluence of the Clodiagh and Owenbeg. Taken together these various records indicate the strong likelihood of the presence of a significant population(s) within the upper Clodiagh/Owenbeg system. It is presumed in light of the aforementioned direct evidence and on the basis of the precautionary principle, that this species is potentially present within the zone of impact influence of the proposal.

There is a risk that the water quality of the local watercourses, that drain the site, could be impaired during the construction stage of the proposed windfarm. It is possible that this could impact negatively on the white-clawed crayfish.

Therefore, it cannot be objectively concluded that significant indirect impacts on the white-clawed crayfish will not ensue from an unmitigated construction phase.

Salmon (*S. salar*) [1106]

As was mentioned previously, current available evidence indicates that this species has a wide distribution within both cSAC river systems. It is presumed in light of the aforementioned evidence and on the basis of the precautionary principle, that this species is potentially present within the zone of impact influence of the proposal.

There is a risk that the water quality of the local watercourses, that drain the site, could be impaired during the construction stage of the proposed windfarm. It is possible that this could impact negatively on the Atlantic salmon. The main potential risk posed by the proposed development is the threat of sedimentation and pollution of waterways and consequent potential loss of spawning habitat during the construction phase. Therefore, it cannot be objectively concluded that significant indirect impacts on the salmon will not ensue from an unmitigated construction phase.

Potential nursery habitat was recorded along the stream to the south of turbines T9 and T10. No suitable salmon nursery habitat was recorded within the other streams within the site boundary.

Sea lamprey (Petromyzon marinus)

Distribution in the Lower River Shannon cSAC

The Current Range and Current Distribution mapping indicates that this species is not present within the tributary system which connects the proposal considered in this document, via the Mulkear River, to the main channel of the River Shannon. The mapping indicates that the nearest record is for 10km Grid square R55 at a location downstream of the point of confluence of the Mulkear and Shannon rivers, near Castletroy in Limerick city. This location is a linear distance in excess of 29km west of the proposal site and separated from it by a watercourse of significantly greater length. It is noted that the weir at Annacotty is a migration barrier that prevents lamprey from accessing the Mulkear of the river[8]. On the basis of the evidence outlined in this paragraph it is concluded that within the Lower River Shannon cSAC downstream of the proposal site, no significant impacts on this species are reasonably foreseeable as a result of the proposal considered in this document.

Distribution in the Lower River Suir cSAC

The Current Range and Current Distribution mapping indicates that that the distribution of the species extends to a location which is in excess of 12km downstream of the point of confluence of the Turaheen/ Multeen system and the Owenbeg/ Suir system (near Golden, County Tipperary). This location, which is in excess of a linear distance of 34km south east of the proposal, is adjacent to Cahir in County Tipperary. O Connor, (2007 p.4) states that sea lamprey were recorded downstream of Cahir, County Tipperary a finding confirmed by the Current range and Distribution mapping which indicates that the species has a wide distribution within the River Suir system spanning the Suir from downstream of Cahir to the lower reaches of the system (NPWS, 2008). It is presumed in light of the aforementioned direct evidence and on the basis of the precautionary principle, that this species is potentially present within the zone of impact influence of the proposal.

There is a risk that the water quality of the local watercourses, that drain the site, could be impaired during the construction stage of the proposed windfarm. It is possible that this could impact negatively on the sea lamprey within the Lower River Suir cSAC downstream of the proposal site.

The main potential risk posed by the proposed development is the threat of sedimentation and pollution of waterways during the construction phase of the proposal. Therefore, it cannot be objectively concluded that significant indirect impacts on the sea lamprey will not ensue from an unmitigated construction phase.

<u>Brook lamprey (Lampetra planeri) [1096] and River lamprey (Lampetra fluviatilis]</u>

Currently no records are retained online at the National Biodiversity Data Centre for these species within the extended river systems of either cSAC. The current known distribution for these species includes the 10km squares within which the proposal considered in this document occurs and the grid squares which incorporate the extended river systems which drain to both cSACs. O Connor (2007) confirmed the presence of these species within the Multeen, upstream of its point of confluence with the Aughnaglanny River, at a site approximately 18km downstream of the proposal site. The same survey recorded these species on the Owenbeg and Clodiagh rivers at sites located up stream of their point of confluence which is situated approximately 9km downstream on the Owenbeg and 19km downstream on the Clodiagh.

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[8] http://www.mulkearlife.com/sea-lamprey.php

It is presumed in light of the aforementioned evidence and on the basis of the precautionary principle, that these species are potentially present within the zone of impact influence of the proposal. within both cSACs.

There is a risk that the water quality of the local watercourses, that drain the site, could be impaired during the construction stage of the proposed windfarm. It is possible that this could impact negatively on the lamprey within the Lower River Suir cSAC downstream of the proposal site.

There is a potential risk of a negative impact on these species from the construction. The main potential risk posed by the proposed development is the threat of sedimentation and pollution of waterways during the construction phase of the proposal. Therefore, it cannot be objectively concluded that significant indirect impacts on lamprey will not ensue from an unmitigated construction phase.

Allis shad (*A. alosa*) [1102]

The Lower River Suir cSAC is designated for the protection of this species because Current Range mapping for this species is only available in 50km grid cells the resolution is less fine than that which is available for other species. However, mapping of the Current Distribution of this species, which is available at 10km grid resolution, indicates that the species is confined to the lower reaches of the Suir system (NPWS, 2008) which is a linear distance of in excess of 60km south east of the proposal site and separated from it by a watercourse of considerably greater length[9]. Therefore, on the basis of the distribution mapping, and bearing in mind the constrained capacity for upstream migration referred to previously, it is considered unlikely that this species occurs within 15km of the proposed development. On the basis of the evidence outlined in this paragraph it is concluded that on this species, within the cSAC, no significant impacts are reasonably foreseeable as a result of the proposal considered in this document.

Twaite shad (*A. fallax* fallax) [1103]

The Lower River Suir cSAC is designated for the protection of this species Because Favourable Reference Range Mapping for this species is only available in 50km grid cells the resolution is less fine than that which is available for other species. However, mapping of the Current Distribution of this species, which is available at 10km grid resolution, indicates that the species s is confined to the lower reaches of the Suir system at a linear distance of in excess of 60km[10] south east of the proposal site and separated from it by a watercourse of considerably greater length. Therefore on the basis of the distribution mapping, and the

[9] Distance measured using 'Measure Distance' Analysis Tool available at http://maps.biodiversityireland.ie/#/Map [accessed 14/08/2012]

[10] Distance measured using 'Measure Distance' Analysis Tool available at http://maps.biodiversityireland.ie/#/Map [accessed 14/08/2012]

evidence sited in the site synopsis, it is considered unlikely that this species occurs within 15km of the proposed development. On the basis of the evidence outlined in this paragraph it is concluded that on this species, within either cSAC, no significant impacts are reasonably foreseeable as a result of the proposal considered in this document.

3.6.2.3 Mammals

Otter (L. lutra)

A search of the NBDC online resource indicates that the most recent, adjacent, records retained for this species are 1980 records included in the 1982 Otter Survey of Ireland[11]. At that time otter were recorded in 100m grid square R947628 approximately 1.3km north east of T21 on the Clodiagh river and in 100m grid square R974594 on the Owenbeg, approximately 1.2km south east of T2.These records, albeit historic, indicate that otters are potentially present within the vicinity of the proposal.

It is presumed in light of the aforementioned evidence and on the basis of the precautionary principle, that these species are potentially present within the zone of impact influence of the proposal.

There is a risk that disturbance due to noise and human presence could cause disturbance or displacement impacts on this species during the construction phase of the proposed windfarm. There is also a risk that the water quality of the local watercourses, that drain the site, could be impaired during the construction stage of the proposed windfarm. It is possible that this could impact negatively on the otter within both the Lower River Shannon cSAC and the Lower River Suir cSAC downstream of the proposal site.

It is considered that the proposal considered in this document could potentially pose a risk of habitat degradation through sedimentation and/or pollution. This could impact the otter directly or indirectly through the reduced availability of prey. Therefore, it cannot be objectively concluded that significant indirect impacts on the otter will not ensue from an unmitigated construction phase.

3.6.3 Water Quality

The potential significant impacts of the proposed development on aquatic ecology (without mitigation) are summarised as follows:

1. *Pollution of watercourses with suspended solids due to runoff of soil from construction areas.*

[11] Available at: http://maps.biodiversityireland.ie/#/Map [accessed 7/06/2012]

In the absence of adequate mitigation measures, contamination of water courses with suspended solids may have the potential to impact on potential salmonid spawning and nursery areas and this is one of the most significant potential impacts of the proposed development. The impact would be classified as a significant negative impact on all affected streams (namely the Clydagh and Breanagh Rivers and their tributaries). Pollution of the local watercourses would result in a direct impact on the SPA and particularly the cSAC.

2. *Pollution of watercourses with nutrients due to ground disturbance during construction and during clear felling of forestry.*

The main potential sources of nutrient inputs to freshwater due to ground disturbance are:

i. Nutrients adsorbed or chemically bound to eroded suspended solids
ii. Leaching of fertilisers used during the forestry operation

3. *Pollution of watercourses with nutrients due to decomposition of brash after forestry clear felling.*

4. *Pollution of watercourses, during construction phase, with other substances such as fuels, lubricants, waste concrete, waste water from wash facilities, etc.*

5. *Pollution of watercourses with surface drainage water from paved areas and road surfaces.*

   There is a risk of pollution of surface waters with hydrocarbons from paved areas after the construction is complete.

6. *Permanent loss of habitat due to stream crossings.*

   Construction of stream crossings at site entrance and installation of box culvert at may result in potential for in-stream deterioration of water quality.

In the absence of adequate mitigation measures, pollution of water courses from any of the above possible sources has the potential to impact on qualifying interests, aquatic species, otter and freshwater habitat within the *Lower River Shannon and Lower River Suir c SACs*. This is the most significant potential impact of the proposed development. The impact, if it resulted in a severe pollution event, would be classified as a significant negative impact on the adjacent stream and on both cSACs. A number of species of qualifying interest could be affected, particularly if spawning success of these species was negatively impacted. Additional impacts would occur, particularly to otter, should availability of prey be reduced.

TABLE 16 SUMMARY OF UNMITIGATED IMPACTS

Ecological Feature	**Potential impacts**	**Potential significance of the unmitigated impact Lower River Shannon cSAC**	**Potential significance of the unmitigated impact Lower River Suir cSAC**
Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation [3260]	• Possible decrease in water quality as a result of run-off of pollution.	**Significant**	**Significant**
Freshwater pearl mussel (*Margaritifera margaritifera*) [1029]	• Possible decrease in habitat quality from sedimentation or pollution. Possible death of glochidia larvae. • Possible decrease in abundance of parasitic salmonid hosts due to sedimentation or pollution of habitat.	*None expected*	**Significant**
White-clawed crayfish (*Austropotamobius pallipes*)[1092]	• Possible decrease in habitat quality from sedimentation or pollution.	<u>Species not a Qualifying Feature of Interest</u>	**Significant**
Atlantic salmon (*Salmo salar*) [1106]	• Possible decrease in habitat quality from sedimentation or pollution and reduction in spawning area.	**Significant**	**Significant**
Sea lamprey (*Petromyzon marinus*)[1095]	• Possible decrease in habitat quality from sedimentation or pollution.	*None expected*	**Significant**

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Ecological Feature	**Potential impacts**	**Potential significance of the unmitigated impact Lower River Shannon cSAC**	**Potential significance of the unmitigated impact Lower River Suir cSAC**
Brook lamprey (*L. Planeri*) [1096] and River lamprey (*Lampetra fluviatilis*) [1099]	• Possible decrease in habitat quality from sedimentation or pollution and reduction in spawning area.	**Significant**	**Significant**
Allis shad (*A. alosa*) [1102]		Species not a Qualifying Feature of Interest	*None expected*
Twaite shad (*A. fallax fallax*) [1103]		Species not a Qualifying Feature of Interest	*None expected*
Otter (*L. lutra*) [1355]	Possible disturbance or displacement impacts from noise and human presence during construction phase. Possible decrease in habitat quality and/or prey availability from sedimentation or pollution.	**Significant**	**Significant**
Ecological Feature	**Potential impacts**	**Potential significance of the unmitigated impact Slieve Felim to Silvermines SPA**	
Hen harrier (*C.cyaneus*) [A082]	Disturbance/displacement from habitat Potential risk of collision	**Not Significant**	

3.7 MITIGATION

Construction of the windfarm has the potential to cause negative short-term and/or permanent impacts to terrestrial habitats within the proposed windfarm site and to aquatic habitats and species in the rivers and streams associated with the site. A number of planned mitigation measures detailed below will reduce these impacts significantly. Many of the mitigation measures below have been based on CIRIA (Construction Industry Research and Information Association, UK) technical guidance on water pollution control and on current accepted best practice.

3.7.1.1 Storage, Stockpiling and Waste Generation Management

All excavated earth materials must be either re-used in an environmentally appropriate and safe manner, e.g. used for landscaping, or removed from the development site at the end of the construction phase.

In addition, a construction phase Environmental Management Plan will be incorporated to include regular checking of equipment, materials storage and transfer areas, drainage structures and their attenuation ability during the construction phase of the project. The purpose of this management control is to ensure that the measures that are put in place continue to operate effectively, to prevent accidental leakages, and to identify potential breaches in the protective retention and attenuation network during earthworks operations

3.7.1.2 Soil, Subsoil and Bedrock Removal

The removal of topsoil, mineral subsoil and bedrock is an unavoidable impact of the development but every effort will be made to ensure that the amount of earth materials excavated is kept to a minimum in order to limit the impact on the geological and hydrological aspects of the site.

A number of mitigation measures have been incorporated into the project design in order to reduce the likely significance of the impacts on the Natura 2000 sites as outlined above. The main concern is the potential impacts on the water quality of watercourses within the Lower River Suir and the Lower River Shannon cSACs during the construction phase, and the subsequent impacts on the aquatic species of qualifying The main risk to the water quality of the streams draining the site, which drain into the nearby Lower River Suir cSAC and the Lower River Shannon cSAC, results from the potential sedimentation of streams, run-off of pollutants from construction discharging into watercourses and accidental fuel spillages. These risks arise from both felling and construction activities. Management measures will be put in place to avoid any pollution risks to the Lower River Suir cSAC and the Lower River Shannon cSAC.

3.7.2 Water Quality Measures during the Construction Phase
It is noted that no in-stream works are proposed. A number of mitigation measures will be implemented in order to reduce the significance of the potential adverse impacts associated with the construction phase.

3.7.2.1 Runoff and sediment control
Erosion control where runoff is prevented from flowing across exposed ground and sediment control where runoff is slowed to allow suspended sediment to settle are important elements in runoff and sediment control. An erosion and sediment control management plan has been designed to prevent sediment and pollutant runoff into the river during the construction phase and is included as **Appendix 15-I**. This plan will be implemented during construction to control increased runoff and associated suspended solid loads in discharging waters from the development areas. The main elements of this plan include:

- Implement erosion control to prevent runoff flowing across exposed ground and becoming polluted by sediments;
- Intercept and divert clean water runoff away from construction site runoff to avoid cross-contamination of clean water with soiled water;
- Implement sediment control to slow down runoff allowing suspended sediments to settle in situ particularly on roads;
- When working at each stage and section (e.g. access road, substation compound, turbine bases, etc) of the development the associated erosion and sediment controls at each section will be put in place prior to construction of each section. Access roads will need to be constructed to access the proposed site for turbine locations. The associated erosion and sediment controls, drains, sediment traps and settling ponds, will be constructed along side these roads and in a conscious manner to ensure that the potential risk to water quality is minimised;
- Minimise area of exposed ground by maintaining existing vegetation that would otherwise be subject to erosion in the vicinity of the windfarm infrastructure and keeping excavated areas to a minimum;
- The clearing of soil and peat associated with the proposed development will take place immediately before construction begins;
- Avoid working near watercourses during or after prolonged rainfall or an intense rainfall event and cease work entirely near drains when it is evident that pollution is occurring;
- Install a series of silt fences or other appropriate silt retention measure where there is a risk of erosion runoff to watercourses from construction related activity particularly if working during prolonged wet weather period or if working during intense rainfall event;

- Implement sediment control measures that includes for the prevention of runoff from adjacent intact ground that is for the separation of clean and 'dirty' water;
- Install appropriate silt control measures such as silt-traps, check dams and sedimentation ponds;
- Provide recommendations for public road cleaning where needed particularly in the vicinity of drains; and
- Controls need to be regularly inspected and maintained otherwise a failure may result, such as a build up of silt or tear in a fence, which will lead to water pollution so controls must work well until the vegetation has re-established; inspection and maintenance is critical after prolonged or intense rainfall.
- Run-off from wind turbine foundation concrete pours shall not be permitted to enter the drainage system and shall be contained within the foundation excavations and designated areas that are suitably sited and designed;
- No work will take place within 50m buffer zones of live watercourses except for the stream crossings.
- All construction method statements will be prepared in consultation with Inland Fisheries Ireland;
- All associated tree felling will be undertaken using good working practices as outlined by the Forest Service in their 'Forestry Harvesting and Environment Guidelines' (Forest Service, 2000a) and the 'Forestry and Water Quality Guidelines '(Forest Service, 2000b). The latter guidelines deal with sensitive areas, erosion, buffer zone guidelines for aquatic zones, ground preparation and drainage, chemicals, fuel and machine oils;
- Drainage ditches or other suitable measures will be adopted alongside access roads, turbines and other disturbed areas to prevent silt or contamination from construction water runoff entering watercourses;
- Check dams will be placed at regular intervals based on slope gradient along all drains to slow down runoff to encourage settlement and to reduce scour and ditch erosion;
- Drains, carrying construction site runoff, will be diverted into silt traps;
- Wheel washes will be provided for exiting heavy vehicles to ensure roads outside of the site boundary are clean;
- Pumped or tremied concrete will be monitored carefully to ensure no accidental discharge into the watercourse;
- A programme of inspection and maintenance of drainage and sediment control measures during construction will be designed and dedicated construction personnel assigned to manage this programme;
- Water quality monitoring will be carried out for two years post-construction to determine whether water quality is impacted.

3.7.2.2 Protection of Watercourses (General Measures)

It is recommended that the following measures should be incorporated into the development so as to ensure no significant negative impact on water course and the features of conservation interest:

- Raw or uncured waste concrete / cementitious material will be disposed of by removal from the site.
- The amount of *in-situ* concreting required will be minimised and ready-mix suppliers will be used in preference to on-site batching.
- Fuelling and lubrication of equipment will be carried out in bunded areas.
- Any spillage of fuels, lubricants or hydraulic oils will be immediately contained and the contaminated soil removed from the site and properly disposed of.
- Oil booms and oil soakage pads will be kept on site to deal with any accidental spillage.
- Waste oils and hydraulic fluids will be collected in leak-proof containers and removed from the site for disposal or re-cycling.
- Prior to any work it will be ensured that all construction equipment is mechanically sound to avoid leaks of oil, fuel, hydraulic fluids and grease.
- Overnight parking of vehicles away from watercourses

3.7.2.3 Run-off and Sediment Control Plan and Measures

A Sediment and Erosion Control Plan will be designed to safeguard the water environment and incorporated into the Construction Environmental Management Plan (CEMP) and other surface water management measures employed during the construction phase of the proposed windfarm (see Chapter 13). The main aspects of the plan are outlined hereunder:

- Reduce changes in run-off regimes
- Control surface water run-off within and its effects outside the site
- Protect aquatic environments
- Separate clean water from construction activity effected water
- Appropriately design and specify the provision of sediment series ponds and silt traps
- Prevent all sediment associated pollution entering watercourses and groundwater

Erosion control where run-off is prevented from flowing across exposed ground and sediment control where run-off is slowed to allow suspended sediment to settle are important elements in run-off and sediment control. This plan will be implemented during construction to control increased run-off and associated suspended solid loads in discharging waters from the construction area. All site compound drainage will be passed through a settlement facility with the capacity to retain any accidental spillage or leakage of polluting substances. The main elements of this plan include:

- Prior to excavation, drains will be established to effectively drain grounds prior to earthworks. Such drains will be positioned at an oblique angle to slope contours to ensure ground stability.
- All site excavations and construction will be supervised by a suitably qualified engineer. The contractor's methodology statement will be reviewed and approved by a suitably qualified engineer prior to site operations.
- Run-off from foundation concrete / cementitious material pours shall not be permitted to enter the watercourse and shall be contained within the foundation excavations and designated areas that are suitably sited and designed.
- The area of exposed ground will be kept to a minimum by maintaining, where possible, existing vegetation.
- Temporary deposition areas will be designated and designed to hold temporary stockpiles of spoil. These will be located away from the stream and stockpiles that are at risk of erosion will be protection by silt trapping apparatus such as a geotextile silt fence to prevent contaminated run-off.
- Silt fences or other appropriate silt retention measure will be installed where there is a risk of erosion run-off to the stream from construction related activity, particularly during prolonged wet weather periods or an intense rainfall event.
- Check dams will be placed at regular intervals based on slope gradient along all drains to slow down run-off to encourage settlement and to reduce scour and ditch erosion.
- Drains carrying construction site run-off will be diverted into silt traps.
- It is recommended that wheel washes will be provided in a bunded area at a remove from the stream.
- Pumped or tremied concrete / cementitious material will be monitored carefully to ensure no accidental discharge into the stream.
- A programme of inspection and maintenance of drainage and sediment control measures during construction will be designed and dedicated construction personnel assigned to manage this programme.
- Silt traps will be regularly inspected, any blockages cleared and they will be maintained and cleaned during dry weather.

A continuous silt fence will be installed down slope from the works area where construction shall take place within 100m of a stream. This will act as a physical impediment to any material or run-off reaching the stream and will be installed prior to the commencement of site excavations for each section. Effective and adequate temporary silt fences will be erected on the river side to trap sediment particles when work is taking place during a prolonged wet weather period or intense rainfall event. The silt fences will be inspected regularly to ensure that the integrity of the structure remains intact and fit for purpose throughout the construction phase of the proposal.

3.7.2.4 Fuel and Oil Management Plan

Fuel management measures will be implemented which will incorporate the following elements:

- Machinery will be confirmed as being mechanically sound and without fuel or oil leaks and fit for purpose prior to project start;
- Use of biodegradable products where possible, e.g. hydraulic fluid;
- Mobile bowsers, tanks and drums will be stored in secure, impermeable storage area, a minimum of 50m from drains and open water;
- Fuel containers must be stored within a secondary containment system e.g. bund for static tanks or a drip tray for mobile stores;
- Ancillary equipment such as hoses, pipes must be contained within the bund;
- Taps, nozzles or valves must be fitted with a lock system;
- Fuel and oil stores including tanks and drums will be regularly inspected for leaks and signs of damage;
- Only designated trained operators will be authorised to refuel plant on site and emergency spill kits will be present at equipment for all refuelling events;
- Procedures and contingency plans will be set up to deal with an emergency accidents or spills; and
- An emergency spill kit with oil boom, absorbers etc. will be kept on site in the event of an accidental spill.
-

3.7.2.5 Replanting and Reinstatement of Site

Exposed areas of the site that are slow to re-vegetate may need to be replanted with suitable vegetation. This will be decided by the developer in consultation with the project ecologist near the end of the construction phase.

As a result of permanent felling, works areas surrounding T3, T9, T12, T14 and T22 will be bare and it is proposed to incorporate these areas into an Ecological Management Plan for the site.

3.7.2.6 Truck Wash and Concrete / Cementitious Material Residue

It is important to prevent concrete and other cementitious material from entering the streams situated in close proximity to the site.

It is recommended that a designated bunded and impermeable truck wash area be provided. Resultant waste water is to be diverted to siltation pond for settling out of solids, prior to release. It is important that a pumping / dewatering system is well planned. Pumped water will need to be treated in the adequate settlement pond and silt trap before it can enter the stream. Among other things, concrete and other cementitious material will be used for the construction and the following measures will be implemented:

- Designate a concrete / cementitious material washout area away from drains and watercourses at a designated, contained impermeable area or washout trucks off-site.
- A designated trained operator experienced in working with concrete and other cementitious material will be employed during the pouring phase.
- Large volumes of concrete and other cementitious material water to be pumped into a skip to settle out.

3.7.2.7 Waste Control

The main contractor should engage a waste company to deal with all its wastes during construction, so all waste streams should be identified at the outset and a selection of skips and bins are delivered to the contractor's compound at the outset and the waste is then managed throughout the construction phase. The contractor should prepare a Waste Management Plan.

Any introduced semi-natural (road building materials) or artificial (PVC piping, cement materials, electrical wiring etc.) must be taken off site at the end of the construction phase. Any accidental spillage of solid state introduced materials must be removed from the site.

3.7.2.8 Storage

The storage of materials, containers, stockpiles and waste, however temporary, should follow best practice at all times and be stored at designated areas. Storage will be located as follows:

- Away from drains and any watercourses or drains
- Fuel oils etc. will be stored in a sheltered area well removed from aquatic zones
- Under cover to prevent damage from the elements
- In secure areas
- Well away from moving plant, machinery and vehicles

All containers will be stored upright and clearly labelled.

3.7.3 Summary of Residual Mitigated Impacts

Table 16 below includes an assessment of the likely residual impacts of the proposed Upperchurch Windfarm provided that all management mitigation measures outlined above are adequately implemented.

TABLE 17: POTENTIAL SIGNIFICANCE OF THE MITIGATED IMPACT

Ecological Feature(s) / Impact	**Potential significance of the unmitigated impact**	**Summary of Mitigation Measures**	**Potential significance of the mitigated**
Freshwater pearl mussel (*Margaritifera margaritifera*) / Impairment of water quality	Significant	• Protection of water quality (general) • Run-off and Sediment Control Plan and Measures • Fuel and Oil Management Plan • Truck Wash and Concrete / Cementitious Material Residue • Waste Control • Storage	Not significant
White-clawed crayfish (*Austropotamobius pallipes*) / Impairment of water quality	Significant		Not significant
Sea lamprey (*Petromyzon marinus*) / Impairment of water quality	Significant		Not significant
River lamprey (*Lampetra fluviatilis*) and brook lamprey (*L. Planeri*) / Impairment of water quality	Significant		Not significant
Atlantic salmon (*Salmo salar)* Impairment of water quality	Significant		Not significant
Otter (*Lutra lutra*) / Impairment of water quality	Significant		Not significant
Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation / Impairment of water quality	Significant		Not significant

4 Conclusion

- The proposed windfarm lies within 15 km of Lower River Shannon cSAC (site code 002165), Bolingbrook Hill cSAC (site code 002124), Lower River Suir cSAC (site code 002137), Anglesey Road cSAC (site code 002125), Slievefelim to Silvermines Mountains SPA (site code 004165), Silvermines mountains West SAC (site code 002258), Keeper Hill SAC (site code 001197), Kilduff, Devilsbit Mountain SAC (site code 000934) and Philipston Marsh SAC (site code 001847). An Appropriate Assessment has been undertaken to determine the significance of the impact on Natura 2000 sites. No adverse impact is expected to arise to Natura 2000 Sites as a result of the proposed development.
- The main potential negative impacts identified relate to habitat loss, disturbance to fauna during construction phase of the development, risk of collision for the hen harrier and the pollution of waterways downstream of the drains/streams within the proposed site.
- A comprehensive erosion and sediment plan has been developed and this will reduce the likelihood of any potential pollution event occurring which could impact on protected sites downstream of the development. Other mitigation measures include the implementation of a fuel management plan, control of wheel wash, dewatering and concrete, and the recommendation for the composition of an ecological management plan prior to construction.
- Pre-construction monitoring will be undertaken for birds and post construction monitoring will be undertaken for the first two year of operation.
- No significant ecological residual impacts are expected as a result of the construction and operational phase of the proposed Upperchurch Windfarm.

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FIGURE 13-II-1: SPECIAL AREAS OF CONSERVATION (SAC) WITHIN 15KM OF THE STUDY AREA

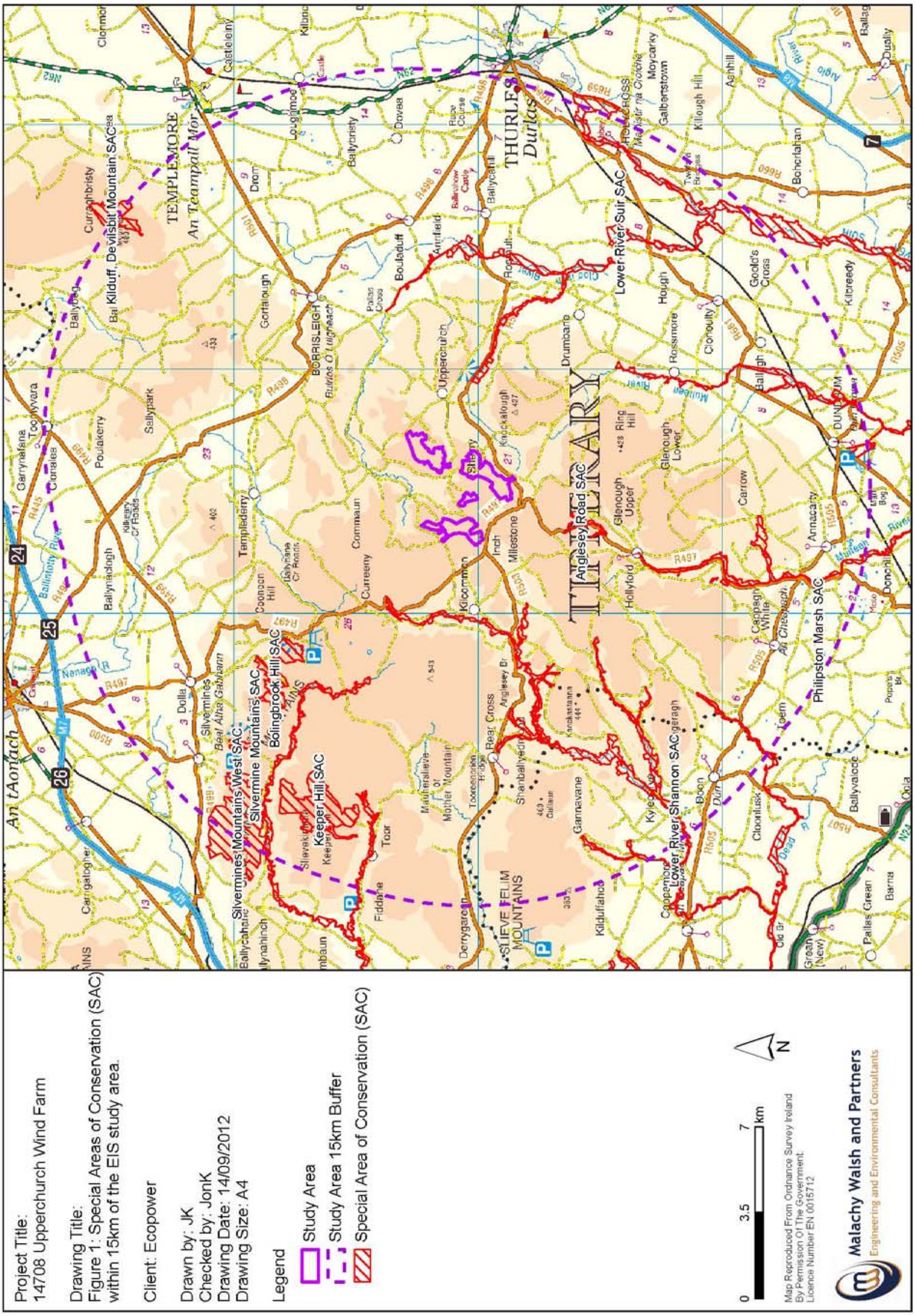
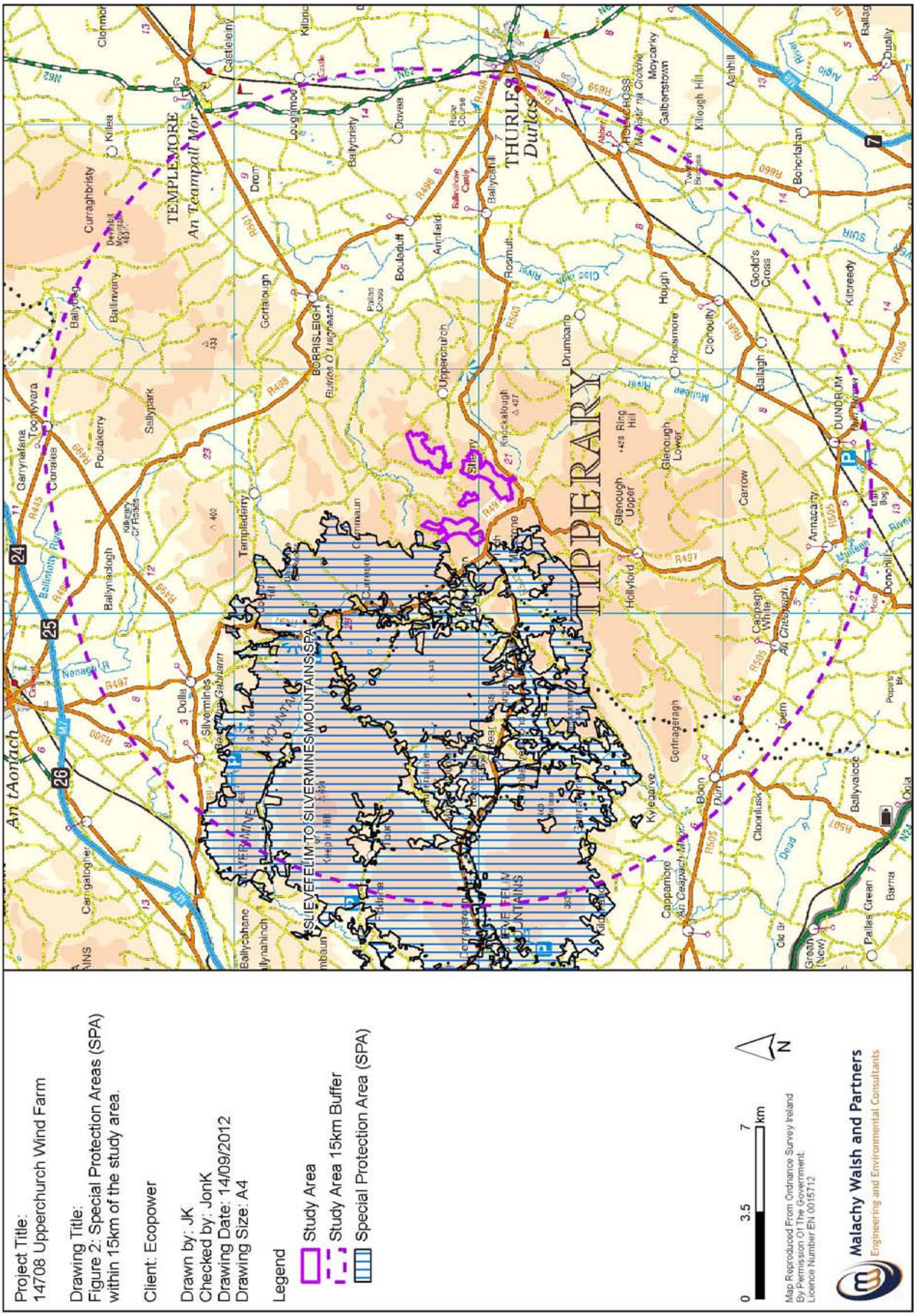


FIGURE 13-II-2: SPECIAL PROTECTION AREAS (SPA) WITHIN 15KM OF THE STUDY AREA



APPENDIX 13- B CONSERVATION OBJECTIVES

Conservation Objectives for Anglesey Road SAC [002125]

The overall aim of the Habitats Directive is to maintain or restore the favourable conservation status of habitats and species of community interest. These habitats and species are listed in the Habitats and Birds Directives and Special Areas of Conservation and Special Protection Areas are designated to afford protection to the most vulnerable of them. These two designations are collectively known as the Natura 2000 network.

European and national legislation places a collective obligation on Ireland and its citizens to maintain habitats and species in the Natura 2000 network at favourable conservation condition. The Government and its agencies are responsible for the implementation and enforcement of regulations that will ensure the ecological integrity of these sites.

The maintenance of habitats and species within Natura 2000 sites at favourable conservation condition will contribute to the overall maintenance of favourable conservation status of those habitats and species at a national level.

Favourable conservation status of a habitat is achieved when:
- its natural range, and area it covers within that range, are stable or increasing, and
- the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and
- the conservation status of its typical species is favourable.

The favourable conservation status of a species is achieved when:
- population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and
- the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

Objective: To maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species for which the SAC has been selected:

- [6230] * Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe)

Citation:

NPWS (2011) Conservation objectives for Anglesey Road SAC [002125]. Generic Version 3.0. Department of Arts, Heritage & the Gaeltacht.

For more information please go to: www.npws.ie/protectedsites/conservationmanagementplanning

Conservation Objectives for Kilduff, Devilsbit Mountain SAC [000934]

The overall aim of the Habitats Directive is to maintain or restore the favourable conservation status of habitats and species of community interest. These habitats and species are listed in the Habitats and Birds Directives and Special Areas of Conservation and Special Protection Areas are designated to afford protection to the most vulnerable of them. These two designations are collectively known as the Natura 2000 network.

European and national legislation places a collective obligation on Ireland and its citizens to maintain habitats and species in the Natura 2000 network at favourable conservation condition. The Government and its agencies are responsible for the implementation and enforcement of regulations that will ensure the ecological integrity of these sites.

The maintenance of habitats and species within Natura 2000 sites at favourable conservation condition will contribute to the overall maintenance of favourable conservation status of those habitats and species at a national level.

Favourable conservation status of a habitat is achieved when:
- its natural range, and area it covers within that range, are stable or increasing, and
- the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and
- the conservation status of its typical species is favourable.

The favourable conservation status of a species is achieved when:
- population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and
- the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

Objective: To maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species for which the SAC has been selected:

- [4030] European dry heaths
- [6230] * Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe)

Citation:

NPWS (2011) Conservation objectives for Kilduff, Devilsbit Mountain SAC [000934]. Generic Version 3.0. Department of Arts, Heritage & the Gaeltacht.

For more information please go to: www.npws.ie/protectedsites/conservationmanagementplanning

Conservation Objectives for Keeper Hill SAC [001197]

The overall aim of the Habitats Directive is to maintain or restore the favourable conservation status of habitats and species of community interest. These habitats and species are listed in the Habitats and Birds Directives and Special Areas of Conservation and Special Protection Areas are designated to afford protection to the most vulnerable of them. These two designations are collectively known as the Natura 2000 network.

European and national legislation places a collective obligation on Ireland and its citizens to maintain habitats and species in the Natura 2000 network at favourable conservation condition. The Government and its agencies are responsible for the implementation and enforcement of regulations that will ensure the ecological integrity of these sites.

The maintenance of habitats and species within Natura 2000 sites at favourable conservation condition will contribute to the overall maintenance of favourable conservation status of those habitats and species at a national level.

Favourable conservation status of a habitat is achieved when:
- its natural range, and area it covers within that range, are stable or increasing, and
- the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and
- the conservation status of its typical species is favourable.

The favourable conservation status of a species is achieved when:
- population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and
- the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

Objective: To maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species for which the SAC has been selected:

- [4010] Northern Atlantic wet heaths with *Erica tetralix*
- [6230] * Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe)
- [7130] Blanket bogs (* if active only)

Citation:

NPWS (2011) Conservation objectives for Keeper Hill SAC [001197]. Generic Version 3.0. Department of Arts, Heritage & the Gaeltacht.

For more information please go to: www.npws.ie/protectedsites/conservationmanagementplanning

Conservation Objectives for Philipston Marsh SAC [001847]

The overall aim of the Habitats Directive is to maintain or restore the favourable conservation status of habitats and species of community interest. These habitats and species are listed in the Habitats and Birds Directives and Special Areas of Conservation and Special Protection Areas are designated to afford protection to the most vulnerable of them. These two designations are collectively known as the Natura 2000 network.

European and national legislation places a collective obligation on Ireland and its citizens to maintain habitats and species in the Natura 2000 network at favourable conservation condition. The Government and its agencies are responsible for the implementation and enforcement of regulations that will ensure the ecological integrity of these sites.

The maintenance of habitats and species within Natura 2000 sites at favourable conservation condition will contribute to the overall maintenance of favourable conservation status of those habitats and species at a national level.

Favourable conservation status of a habitat is achieved when:
- its natural range, and area it covers within that range, are stable or increasing, and
- the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and
- the conservation status of its typical species is favourable.

The favourable conservation status of a species is achieved when:
- population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and
- the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

Objective: To maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species for which the SAC has been selected:

- [7140] Transition mires and quaking bogs

Citation:

NPWS (2011) Conservation objectives for Philipston Marsh SAC [001847]. Generic Version 3.0. Department of Arts, Heritage & the Gaeltacht.

For more information please go to: www.npws.ie/protectedsites/conservationmanagementplanning

Conservation Objectives for Bolingbrook Hill SAC [002124]

The overall aim of the Habitats Directive is to maintain or restore the favourable conservation status of habitats and species of community interest. These habitats and species are listed in the Habitats and Birds Directives and Special Areas of Conservation and Special Protection Areas are designated to afford protection to the most vulnerable of them. These two designations are collectively known as the Natura 2000 network.

European and national legislation places a collective obligation on Ireland and its citizens to maintain habitats and species in the Natura 2000 network at favourable conservation condition. The Government and its agencies are responsible for the implementation and enforcement of regulations that will ensure the ecological integrity of these sites.

The maintenance of habitats and species within Natura 2000 sites at favourable conservation condition will contribute to the overall maintenance of favourable conservation status of those habitats and species at a national level.

Favourable conservation status of a habitat is achieved when:
- its natural range, and area it covers within that range, are stable or increasing, and
- the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and
- the conservation status of its typical species is favourable.

The favourable conservation status of a species is achieved when:
- population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and
- the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

Objective: To maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species for which the SAC has been selected:

- [4010] Northern Atlantic wet heaths with *Erica tetralix*
- [4030] European dry heaths
- [6230] * Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe)

Citation:

NPWS (2011) Conservation objectives for Bolingbrook Hill SAC [002124]. Generic Version 3.0. Department of Arts, Heritage & the Gaeltacht.

For more information please go to: www.npws.ie/protectedsites/conservationmanagementplanning

Conservation Objectives for Lower River Suir SAC [002137]

The overall aim of the Habitats Directive is to maintain or restore the favourable conservation status of habitats and species of community interest. These habitats and species are listed in the Habitats and Birds Directives and Special Areas of Conservation and Special Protection Areas are designated to afford protection to the most vulnerable of them. These two designations are collectively known as the Natura 2000 network.

European and national legislation places a collective obligation on Ireland and its citizens to maintain habitats and species in the Natura 2000 network at favourable conservation condition. The Government and its agencies are responsible for the implementation and enforcement of regulations that will ensure the ecological integrity of these sites.

The maintenance of habitats and species within Natura 2000 sites at favourable conservation condition will contribute to the overall maintenance of favourable conservation status of those habitats and species at a national level.

Favourable conservation status of a habitat is achieved when:
- its natural range, and area it covers within that range, are stable or increasing, and
- the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and
- the conservation status of its typical species is favourable.

The favourable conservation status of a species is achieved when:
- population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and
- the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

Objective: To maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species for which the SAC has been selected:

- [1029] *Margaritifera margaritifera*
- [1092] *Austropotamobius pallipes*
- [1095] *Petromyzon marinus*
- [1096] *Lampetra planeri*
- [1099] *Lampetra fluviatilis*
- [1103] *Alosa fallax*
- [1106] *Salmo salar* (only in fresh water)
- [1330] Atlantic salt meadows (*Glauco-Puccinellietalia* maritimae)
- [1355] *Lutra lutra*
- [1410] Mediterranean salt meadows (*Juncetalia maritimi*)
- [3260] Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation
- [6430] Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels
- [91A0] Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles

Citation:

NPWS (2011) Conservation objectives for Lower River Suir SAC [002137]. Generic Version 3.0. Department of Arts, Heritage & the Gaeltacht.

For more information please go to: www.npws.ie/protectedsites/conservationmanagementplanning

- [91E0] * Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*)
- [91J0] * *Taxus baccata* woods of the British Isles

Citation:

NPWS (2011) Conservation objectives for Lower River Suir SAC [002137]. Generic Version 3.0. Department of Arts, Heritage & the Gaeltacht.

For more information please go to: www.npws.ie/protectedsites/conservationmanagementplanning

Conservation Objectives for Lower River Shannon SAC [002165]

The overall aim of the Habitats Directive is to maintain or restore the favourable conservation status of habitats and species of community interest. These habitats and species are listed in the Habitats and Birds Directives and Special Areas of Conservation and Special Protection Areas are designated to afford protection to the most vulnerable of them. These two designations are collectively known as the Natura 2000 network.

European and national legislation places a collective obligation on Ireland and its citizens to maintain habitats and species in the Natura 2000 network at favourable conservation condition. The Government and its agencies are responsible for the implementation and enforcement of regulations that will ensure the ecological integrity of these sites.

The maintenance of habitats and species within Natura 2000 sites at favourable conservation condition will contribute to the overall maintenance of favourable conservation status of those habitats and species at a national level.

Favourable conservation status of a habitat is achieved when:

- its natural range, and area it covers within that range, are stable or increasing, and
- the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and
- the conservation status of its typical species is favourable.

The favourable conservation status of a species is achieved when:

- population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and
- the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

Objective: To maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species for which the SAC has been selected:

- [1029] *Margaritifera margaritifera*
- [1095] *Petromyzon marinus*
- [1096] *Lampetra planeri*
- [1099] *Lampetra fluviatilis*
- [1106] *Salmo salar* (only in fresh water)
- [1110] Sandbanks which are slightly covered by sea water all the time
- [1130] Estuaries
- [1140] Mudflats and sandflats not covered by seawater at low tide
- [1150] * Coastal lagoons
- [1160] Large shallow inlets and bays
- [1170] Reefs
- [1220] Perennial vegetation of stony banks
- [1230] Vegetated sea cliffs of the Atlantic and Baltic coasts
- [1310] *Salicornia* and other annuals colonizing mud and sand
- [1330] Atlantic salt meadows (*Glauco-Puccinellietalia* maritimae)

Citation:

NPWS (2011) Conservation objectives for Lower River Shannon SAC [002165]. Generic Version 3.0. Department of Arts, Heritage & the Gaeltacht.

For more information please go to: www.npws.ie/protectedsites/conservationmanagementplanning

- [1349] *Tursiops truncatus*
- [1355] *Lutra lutra*
- [1410] Mediterranean salt meadows (*Juncetalia maritimi*)
- [3260] Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation
- [6410] *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*)
- [91E0] * Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*)

Citation:

NPWS (2011) Conservation objectives for Lower River Shannon SAC [002165]. Generic Version 3.0. Department of Arts, Heritage & the Gaeltacht.

For more information please go to: www.npws.ie/protectedsites/conservationmanagementplanning

Conservation Objectives for Silvermines Mountains West SAC [002258]

The overall aim of the Habitats Directive is to maintain or restore the favourable conservation status of habitats and species of community interest. These habitats and species are listed in the Habitats and Birds Directives and Special Areas of Conservation and Special Protection Areas are designated to afford protection to the most vulnerable of them. These two designations are collectively known as the Natura 2000 network.

European and national legislation places a collective obligation on Ireland and its citizens to maintain habitats and species in the Natura 2000 network at favourable conservation condition. The Government and its agencies are responsible for the implementation and enforcement of regulations that will ensure the ecological integrity of these sites.

The maintenance of habitats and species within Natura 2000 sites at favourable conservation condition will contribute to the overall maintenance of favourable conservation status of those habitats and species at a national level.

Favourable conservation status of a habitat is achieved when:
- its natural range, and area it covers within that range, are stable or increasing, and
- the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and
- the conservation status of its typical species is favourable.

The favourable conservation status of a species is achieved when:
- population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and
- the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

Objective: To maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species for which the SAC has been selected:

- [4010] Northern Atlantic wet heaths with *Erica tetralix*
- [4030] European dry heaths

Citation:

NPWS (2011) Conservation objectives for Silvermines Mountains West SAC [002258]. Generic Version 3.0. Department of Arts, Heritage & the Gaeltacht.

For more information please go to: www.npws.ie/protectedsites/conservationmanagementplanning

Conservation Objectives for Slievefelim to Silvermines Mountains SPA [004165]

The overall aim of the Habitats Directive is to maintain or restore the favourable conservation status of habitats and species of community interest. These habitats and species are listed in the Habitats and Birds Directives and Special Areas of Conservation and Special Protection Areas are designated to afford protection to the most vulnerable of them. These two designations are collectively known as the Natura 2000 network.

European and national legislation places a collective obligation on Ireland and its citizens to maintain habitats and species in the Natura 2000 network at favourable conservation condition. The Government and its agencies are responsible for the implementation and enforcement of regulations that will ensure the ecological integrity of these sites.

The maintenance of habitats and species within Natura 2000 sites at favourable conservation condition will contribute to the overall maintenance of favourable conservation status of those habitats and species at a national level.

Favourable conservation status of a habitat is achieved when:
- its natural range, and area it covers within that range, are stable or increasing, and
- the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and
- the conservation status of its typical species is favourable.

The favourable conservation status of a species is achieved when:
- population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and
- the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

Objective: To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA:

- *Circus cyaneus* [breeding]

Citation:

NPWS (2011) Conservation objectives for Slievefelim to Silvermines Mountains SPA [004165]. Generic Version 4.0. Department of Arts, Heritage & the Gaeltacht.

For more information please go to: www.npws.ie/protectedsites/conservationmanagementplanning

Upperchurch Windfarm Environmental Impact Statement

Malachy Walsh and Partners

Consulting Engineers

Cork | Tralee | Limerick | London

WINDFARM DEVELOPMENT
UPPERCHURCH, THURLES, COUNTY TIPPERARY

GEOTECHNICAL ASSESSMENT REPORT

ECOPOWER DEVELOPMENTS LIMITED

Project	Document	Revision	Prepared	Checked	Status	Date
14708	6003	A	Sean Doyle	Jack O'Leary	Draft	18 June 2012

14 Geotechnical

14.1 INTRODUCTION

It is proposed to construct a 22 turbine wind farm in the area immediately to the west of Upperchurch and 18km to the west of Thurles, County Tipperary. The turbines, which are numbered T01 to T22 are arranged in four clusters within an overall area of $12km^2$. This study assesses the potential impact of the wind farm development proposals on the soils and geology of the area.

A desk study was undertaken to collate and review all available information from existing datasets and documentation sources relating to the site's natural environment and included the following:

- Examination of maps and aerial photography;
- Examination of the Geological Survey of Ireland (GSI) datasets pertaining to geological and extractive industry data;
- Examination of EPA soil and subsoil maps;
- Examination of National Parks and Wildlife Service (NPWS) nature conservation designations.

Site visits were undertaken on 28th October 2011, 11th & 12th April and 10th May 2012 during which field surveys were carried out. These surveys identified geological and soil features, peat extent and depth, geomorphological features, relict failures, rock exposures, wet ground, general soil and rock types and drainage patterns. Trial pits were excavated at 20 of the proposed turbine sites and peat depth and classification was measured at the remaining two sites (T05 & T14) which are in forested areas. Ground surface slope was measured at all turbine sites. The trial pit logs and photographs are included in **Appendix 14-I**.

14.2 EXISTING ENVIRONMENT

14.2.1 General

The Upperchurch wind farm site is located within a series of small hills or drumlins to the west of Upperchurch village. The hills are at elevations of between 363mOD and 411mOD and the peaks are generally at heights of 100m above the intervening lower terrain. The highest peak is that of Knockmaroe at an elevation of 411mOD.

The Slievefelim to Silvermines Mountains SPA lies to the west of the site. Most of the site is within the South Eastern River Basin District and drains to the Owenbeg Turraheen and Clodiagh Rivers and ultimately to the River Suir. The remaining part of the site at the south western extremity is within the Shannon River Basin District and drains to the Aughvana River and ultimately to the Mulkear River.

The area is underlain by Silurian Metasediments and Volcanics with subsoils consisting of Devonian / Carboniferous sandstone and shale till. Some rock outcropping occurs, most notably at the northeast part of the site. The area originally had shallow peat land cover but most of it has been reclaimed by deep ploughing and converted to pasture. The remaining peat areas are used mainly for commercial forestry.

Overall it is a landscape much altered by human activity.

14.2.2 Geological heritage

The Irish Geological Heritage Programme identifies and selects a complete range of sites that represent Ireland's geological heritage under sixteen themes ranging from Karst features to Hydrogeology. Consultation with GSI Geological Heritage Database and the GSI indicates that there is a feature approximately 3.50km to the south of the site at Irish National Grid coordinate E:193850, N:155900. This feature (IGH2-34) is designated as a Precambrian to Devonian Palaeontology fossil from the Silurian era.

14.2.3 Regional geology

The geology of the Tipperary region (GSI Sheet 18) is dominated by the sedimentary rocks of the Carboniferous Period. Within this greater area is the Slievefelim-Devilsbit Inlier which is the largest of the Irish Lower Palaeozoic Inliers. The rocks in the inlier are from the mid-Silurian Period dating back c400 million years. The inlier is represented by the Hollyford Formation which consists of greywacke, siltstone and grit and the surrounding Cappagh White Formation from the Devonian Period which consists of red and white sandstone and conglomerates. The formations pre-date the surrounding Carboniferous rocks and were exposed by erosion of anticlinal folds which were formed during the late Carboniferous or Permian Period earth movements.

The Upperchurch site, which lies to the west of Mauher Slieve on the Slievefelim-Devilsbit mountain range, is wholly within the Hollyford Formation (Refer to **Figure 14-1: Bedrock Geology** map at the end of this Chapter). The siltstone bedrock encountered in the site investigations and visible as outcrops in the general area is consistent with the rock type of this formation.

14.2.4 Extractive industry and historic borrow pits

The geological survey of Ireland database for mines and extractions showed up a number of quarries and stone extraction areas located within 20km of the proposed site as outlined below.

- Gortdrum Stone Company sandstone quarry, Gortdrum, County Tipperary is located 20km south southwest of the site and 30km southwest of Thurles at E:187556, N:140592;
- Roadstone Killough limestone Quarry, Thurles is located 18km southeast of the site and 8km south of Thurles at E:211100, N:150700;
- Fantane grit and siltstone quarry, Borrisoleigh is located 6km north northeast of the site at E:198600, N:168456;
- Grawn sand and gravel quarry, Latteragh, County Tipperary is located 8km to the north of the site at E:197530, N:170980;
- Harney Quarries, Cloncannon, Moneygall, Roscrea, County Tipperary is located 16km to the northeast of the site at E:203400, N:177900;
- Latteragh quarry, Lackenavorna, Nenagh, County Tipperary is located 10km to the north of the site at E:196100, N:172700;
- Toor pit, Doonane, Newport is located 16km to the west of the site at E:177700, N:164870;
- There is a mine located 20km west southwest of the site at E:187500, N:140700. Copper, silver and mercury are extracted from this mine;
- There is also a mine 20km southwest of the site at E:183000, N:142500 from which sphalerite and galena are extracted;
- There are also borrow pits on neighbouring wind farms to the south, that have subsequently been filled in.

The locations of the quarries are shown in **Figure 14-5: Quarry Locations**, at the end of this Chapter.

14.3 GEOTECHNICAL

14.3.1 Subsoils

The GSI subsoil geology maps indicate rock at the surface for most of the site with some areas being represented by sandstone and shale till from the Lower Palaeozoic Period. The site investigation trial pits at the turbine locations exposed subsoils consistent with the geology maps with siltstone bedrock close to the surface, overlain by weathered siltstone or shale till derived chiefly from Lower Palaeozoic rocks (Refer to **Figure 14-2: Subsoil Geology** map and Trial Pit logs in **Appendix 14-I**, at the end of this Chapter).

14.3.2 Soils

The soil type varies considerably throughout the site but consists mainly of the following types:

- Lithosols / Rogosols derived mainly from acidic parent materials which are shallow well drained minerals;
- Surface water Gleys / Ground water Gleys derived mainly from acidic parent materials which consist of deep and poorly drained minerals (AminPD);
- Acid Brown Earths / Brown Podzolics derived mainly from acidic parent materials which are deep well drained minerals (AminDW).

The hilltop areas include Peaty Podzolic and Peaty Gley soils.

The primary land use is pasture with some areas of higher ground used for commercial forestry. Refer to Soil Geology map in **Figure 14-3** at the end of this Chapter.

14.3.3 Peat

Much of the hilltop areas were originally covered in shallow peat but most of this has been reclaimed for agricultural use. The remaining peat areas are now almost exclusively used for forestry. Peat depths are typically less than a metre in depth with many areas showing less than 0.30m depth. Shear vane testing and Von Post classification of the peat layer was not carried out because of the shallow depth and low ground slopes which individually or in combination are indicative of low risk of instability.

14.3.4 Composition and character of mineral soils

The composition of the mineral soils was determined by mechanical excavation of trial pits at each of the turbine locations, with the exception of T05 and T14 where only peat depths were recorded. The trial pits indicate a predominance of siltstone till with some occurrences of shale and clay layers. The trial pit logs are included in **Appendix 14-I**.

14.3.5 Ground stability

All parts of the site were examined during the course of the site investigation works. This did not reveal any stress indicators in the form of erosion and there is no evidence of historical peat slides in the area.

Recorded peat slides or landslides in the wider area are:

- A bog burst in Cappamurra Bog, County Tipperary in 1788 which is situated 14km south southwest of the wind farm site;
- An unspecified landslide that occurred at Cummer More, County Tipperary in 1995, 4.20km southwest of the wind farm site.

14.3.6 Slope measurements

Ground slope measurements were taken at each turbine location. The slopes ranged from a minimum of 0.06 at T03 to a maximum of 0.20 at T05. The values for each location are as follows:

Turbine	Gradient	Angle (degrees)
T01	0.16	8.87
T02	0.14	7.97
T03	0.06	3.21
T04	0.16	9.15
T05	0.20	11.31
T06	0.16	9.20
T07	0.17	9.70
T08	0.12	6.73
T09	0.17	9.82
T10	0.11	6.11
T11	0.09	5.14
T12	0.18	10.43
T13	0.16	9.15
T14	0.13	7.52
T15	0.13	7.24
T16	0.12	6.67
T17	0.10	5.94
T18	0.10	5.77
T19	0.09	5.03
T20	0.12	6.73
T21	0.10	5.54
T22	0.11	6.39

TABLE 14.1 – GROUND SLOPES AT TURBINE SITES

These values will be taken into account in the detailed design of the turbine bases but the information from the trial pits indicates that the ground is inherently stable and there is no particular risk of failure.

14.3.7 Site drainage

All of the proposed wind turbine locations and site access roads are on elevated sloping ground with good natural drainage to the streams in the surrounding valleys which form the upper reaches of a number of rivers in the area. Most of the site lies within the South Eastern River Basin District and drains to the Turaheen, Owenbeg and Clodiagh Rivers, all of which ultimately drain to the River Suir. The remaining part of the site at its south western extremity is within the Shannon River Basin District and drains to the Aughvana River which joins the Mulkear River east of Cappamore and ultimately into the Shannon immediately upstream of Limerick City.

14.3.8 Summary of geotechnical and soil stability

There is a very low risk of slippage or landslides in the Upperchurch wind farm site because of the stable sub-surface ground conditions as determined in the site investigations and the absence of any significant peat coverage. Mitigation measures, based on precautionary principles, as outlined in Section 14.4 will ensure that the level of risk will not increase as a result of construction activities.

14.4 LIKELY SIGNIFICANT IMPACTS

14.4.1 Construction Phase Impacts

14.4.1.1 Primary Construction Activities

The development is characterised by the following civil engineering works which will be undertaken to provide the necessary infrastructure to complete the wind farm:

- Excavation for the construction of 22 turbine bases with a minimum depth of 2.00m and 250m^2 plan area and hardstands with and excavation depth of 0.60m and 1,040m^2 plan area;
- Erection of 22 turbines with hub heights of up to 85m and maximum tip heights of up to 126.60m;
- Construction of 8km of 5.00m wide new roads;
- Widening and upgrading of 3.6km of existing farm roads (average 2m widening);
- Construction of an electrical sub-station compound with excavation depth of 0.60m and 2,624m^2 plan area;
- Construction of an electrical sub-station and installation of associated equipment;
- Laying electrical cable between turbines and sub-station compound;
- Construction of a surface water drainage system along the road edges; and
- Importation of stone, as required, from borrow pits or from local quarries for construction of access roads and hard standings.

The volumes of material to be excavated are summarised in Table 14.2.

ELEMENT	TOPSOIL (M^3)	PEAT (M^3)	SUBSOIL (M^3)
TURBINE T01	540		4,281
TURBINE T02	527		3,832
TURBINE T03	481		2,160
TURBINE T04	540		4,281
TURBINE T05		570	5,318
TURBINE T06	540		4,281
TURBINE T07	545		4,433
TURBINE T08	518		3,255
TURBINE T09	545		4,433
TURBINE T10	507		3,160
TURBINE T11	498		2,725
TURBINE T12	550		4,798
TURBINE T13	540		4,281
TURBINE T14		520	3,603
TURBINE T15	520		3,603
TURBINE T16	518		3,255
TURBINE T17	505		2,928
TURBINE T18	505		2,928
TURBINE T19	498		2,725
TURBINE T20	518		3,255
TURBINE T21	505		2,928
TURBINE T22	507		3,160
NEW ROADS	13,050	900	0
WIDENED ROADS	2,070	360	0
SUB-TOTALS	25,527	2,350	79,623
TOTAL	107,500		

TABLE 14.2 – VOLUMES OF MATERIALS TO BE EXCAVATED

14.4.1.2 Soil, Subsoil and Bedrock removal

Implementation of the development will result in the removal of soil, subsoil and rock in parts of the site in order to facilitate the construction of access roads, crane hard standings, sub-station compound and turbine bases. This soil will be reused within the construction site for backfilling around turbine bases and for landscaping post construction. Removal of the soil and subsoil is a direct permanent impact on the environment but is considered to be a minor impact given the scale of the project.

In 18 out of the 20 trial pits that were excavated, bedrock was encountered at an average depth of 1.90m below the surface, the minimum and maximum depths being 1.20m and 2.90m respectively. Bedrock consisted of siltstone or hard shale. The two remaining trial pits were excavated in stiff clay to depths of 1.50m and 2.70m. Some bedrock will be excavated for the turbine bases where it is shallow although the volumes will be minimal. The removal of this bedrock will be a direct minor impact of the construction phase.

14.4.1.3 Borrow Pits

A number of suitable locations have been identified for borrow pits for the extraction of material for road construction within the site. The locations of the borrow pits in Irish National Grid coordinates are shown in Table 14.3 below and shown in **Figure 14.6** at the end of this chapter.

ID	Easting	Northing	Location
1	195,190	158,858	300m east of T01
2	195,852	159,751	100m north of T04
3	196,267	160,330	140m west of T06
4	196,359	162,215	150m southeast of T12
5	193,663	160,497	300m southeast of T18
6	193,504	161,777	40m southwest of T20

TABLE 14.3 – LOCATION OF BORROW PITS

The removal of material from the borrow pits will be a permanent minor impact of the construction phase.

14.4.1.4 Vehicular Movement

Most of the traffic movement within the site during the construction phase will be over new roads. Vehicles will traverse the ground surface or excavate into the soil and subsoil in the course of construction of new access roads and widening of existing roads and construction of turbine bases, crane hardstandings, sub-station and temporary construction compounds. This will be a minor negative short to medium term direct impact on the in-situ surface and subsurface materials.

14.4.1.5 Ground Stability

Because of the shallow depths of peat, which was encountered at 2 of the 22 turbine loaction, and the inherent stability of the sub-soils there will be no particular risk to ground stability on any part of the wind farm site. Notwithstanding this, inappropriate excavation methods could lead to instability, albeit of a very local nature.

14.4.1.6 Storage, Stockpiles and Waste Generation

The handling, storage and re-use of excavated materials during the construction phase of the development can be significant in terms of impact. There is potential for negative direct and indirect short-term minor impact on ground stability and negative direct and indirect short-term moderate to significant impact on water quality. A possible example of this would be slope failure due to excessive loading (surcharge) from stockpiled material and the resultant release of sediment and suspended solids to the surface water system.

Approximately 28,000m^3 of topsoil and peat will have to be excavated as part of the construction of Upperchurch wind farm. It is envisaged that topsoil will be formed into bunds along the access roads and around the crane hardstand areas. These bunds will be constructed to a maximum height of 1.0m with a width at base of 3.0m and side slopes of 2:1. The drainage regime will be considered when constructing the bunds in order to reduce the risk of sediment runoff to clean water drains.

14.4.1.7 Risk of Pollution from Hydrocarbon Leakage

The plant and equipment that will be used during the construction phase will be run on hydrocarbons. This means that mobile plant will require regular re-fuelling from an on-site fuelling station or by direct re-fuelling from scheduled truck deliveries. This creates the potential for spillage and leakage of hydrocarbons from plant or from on-site storage stations during construction.

Hydrocarbons are a pollution risk due to their toxicity to all flora and fauna organisms. A hydrocarbon adsorbs (sticks) onto the majority of natural solid objects it encounters such as vegetation, animals or earth materials. It burns most living organic tissue such as vegetation because of its volatile chemistry. Contaminated earth materials may then act as a pathway for pollution of receptors such as water and groundwater. Refer also to Chapter 15 – Hydrological Impacts.

An accidental hydrocarbon spillage would have a negative short to medium term moderate impact on the vegetation and earth materials at and downhill from the development site.

14.4.2 Operational Phase Impacts

No new impacts will arise during the operational phase of the project on the geological environment. However, due to the alteration of the environment, rainwater falling on the development footprint will follow an altered drainage regime which is expected to be an indirect minor impact. Refer to Chapter 15 – Hydrological Impacts for details.

14.5 MITIGATION MEASURES

14.5.1 Construction phase

Construction of the wind farm has the potential to cause negative short-term to permanent minor to significant impacts to the soils and geology of the permitted development site. A number of planned mitigation measures detailed below will reduce these impacts significantly. Many of the mitigation measures below have been based on CIRIA (Construction Industry Research and Information Association, UK) technical guidance on water pollution control and on current accepted best practice.

14.5.1.1 Soil, Subsoil and Bedrock Removal

The removal of topsoil, mineral subsoil and bedrock is an unavoidable impact of the development but every effort will be made to ensure that the amount of earth materials excavated is kept to a minimum in order to limit the impact on the geological and hydrological aspects of the site.

14.5.1.2 Construction Activities

The first priority of the construction phase will be to construct the access road network and upgrade the existing roads and the spine roads in particular so that they are capped with limestone or similar quality stone to reduce the potential for road degradation. Vehicular movements will be restricted to the footprint of the proposed development, particularly with respect to the newly constructed access roads. This implies that machinery must be kept on roads and aside from advancing excavations do not move onto areas that are not permitted for the development.

14.5.1.3 Ground Stability

The geotechnical investigations at the proposed Upperchurch Wind Farm indicate that the site has a very low risk of slope failures or landslides due to the virtual absence of peat on the site. Slopes are moderate over most of the development footprint. It is noted that geotechnical investigations indicate stable conditions throughout the extent of the areas investigated and therefore constraint mapping was not required for this site. As a precautionary principle, however, the following procedures are recommended as best-practise mitigation measures to avoid slope instability, even of a very local nature, at wind farm sites. These are:

- Drains will be established to effectively drain grounds prior to excavation or earthworks of each section of road. Such drains will be positioned at an oblique angle to slope contours to ensure ground stability;
- All site excavations should be planned and overseen in conjunction a suitably qualified engineer. The contractor's method statement will be reviewed and approved by a suitably qualified geotechnical engineer prior to site operations.

14.5.1.4 Storage, Stockpiling and Waste Generation Management

All excavated earth materials must be either re-used in an environmentally appropriate and safe manner, e.g. used for landscaping, or removed from the development site at the end of the construction phase. Permanent stockpiles above existing ground level are not recommended at the site.

Any introduced semi-natural (road building materials) or artificial (PVC piping, cement materials, electrical wiring etc.) materials that are left over must be taken off site at the end of the construction phase. Any accidental spillage of solid state introduced materials must be removed from the site.

In addition, a construction phase Environmental Management Plan will be incorporated to include regular checking of equipment, materials storage and transfer areas, drainage structures and their attenuation ability during the construction phase of the project. The purpose of this management control is to ensure that the measures that are put in place continue to operate effectively, to prevent accidental leakages, and to identify potential breaches in the protective retention and attenuation network during earthworks operations.

It is also recommended that a fuel management plan is implemented. The plan should incorporate the following elements:

- Mobile bowsers, tanks and drums will be stored in secure, impermeable storage areas away from drains and open water;
- Fuel containers must be stored within a secondary containment system, e.g. bunds for static tanks or a drip tray for mobile stores;
- Ancillary equipment such as hoses and pipes must be contained within the bund;
- Taps, nozzles or valves must be fitted with a lock system;
- Fuel and oil stores including tanks and drums will be regularly inspected for leaks and signs of damage;
- Only designated trained operators will be authorised to refuel plant on site;
- Procedures and contingency plans will be set up to deal with emergency accidents or spills; and

- An emergency spill kit with oil boom, absorbers etc. is to be kept on site for use in the event of an accidental spill.

14.5.2 Drainage

The permanent road works will require a drainage network to be in place for the construction and operational phases of the wind farm. This will necessitate the construction of adequately sized settlement ponds and silt traps to deal with water that has become contaminated with silt. The site drainage will be regularly monitored, and maintained to ensure the constructed drainage performs through to the operational phase of the project and is fit for purpose thereafter. Refer to the Sediment and Erosion plan included in **Appendix 15-I** at the end of Chapter 15.

14.6 RESIDUAL IMPACTS

Following on from the detailed site surveys carried out in conjunction with a review of existing data, mapping, geology and drainage features on site it is clear that there are some limited potential negative impacts during the construction phase of the works. However, given the low risk nature of the site and in light of the mitigation measures outlined above it is considered that there will be no significant residual impact to soils and geology following the development of this project.

14.7 CONCLUSION

The development of this wind farm at Upperchurch will not have a significant impact on Soils and Geology given the inherent low risk nature of the site and provided that the mitigation measures outlined above are implemented.

14.8 REFERENCES

1. Geological Survey of Ireland online Geology Mapping.
2. Geological Survey of Ireland (2001) “Directory of Active Quarries, Pits and Mines in Ireland”
3. Geological Survey of Ireland (July 2009) “Consultation with National Landslides Database”.

FIGURE 14-1: BEDROCK GEOLOGY

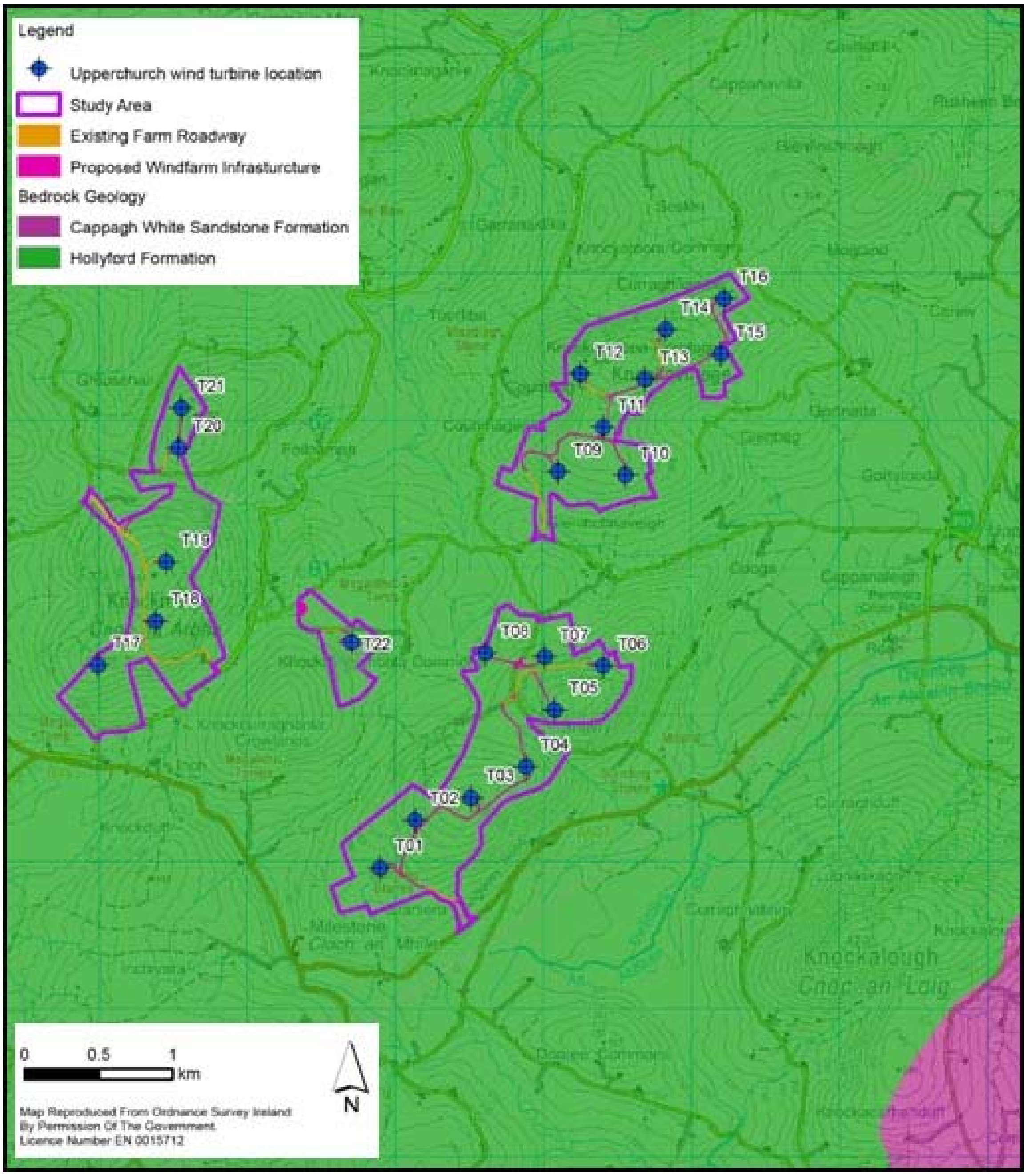


FIGURE 14-2: SUBSOIL GEOLOGY

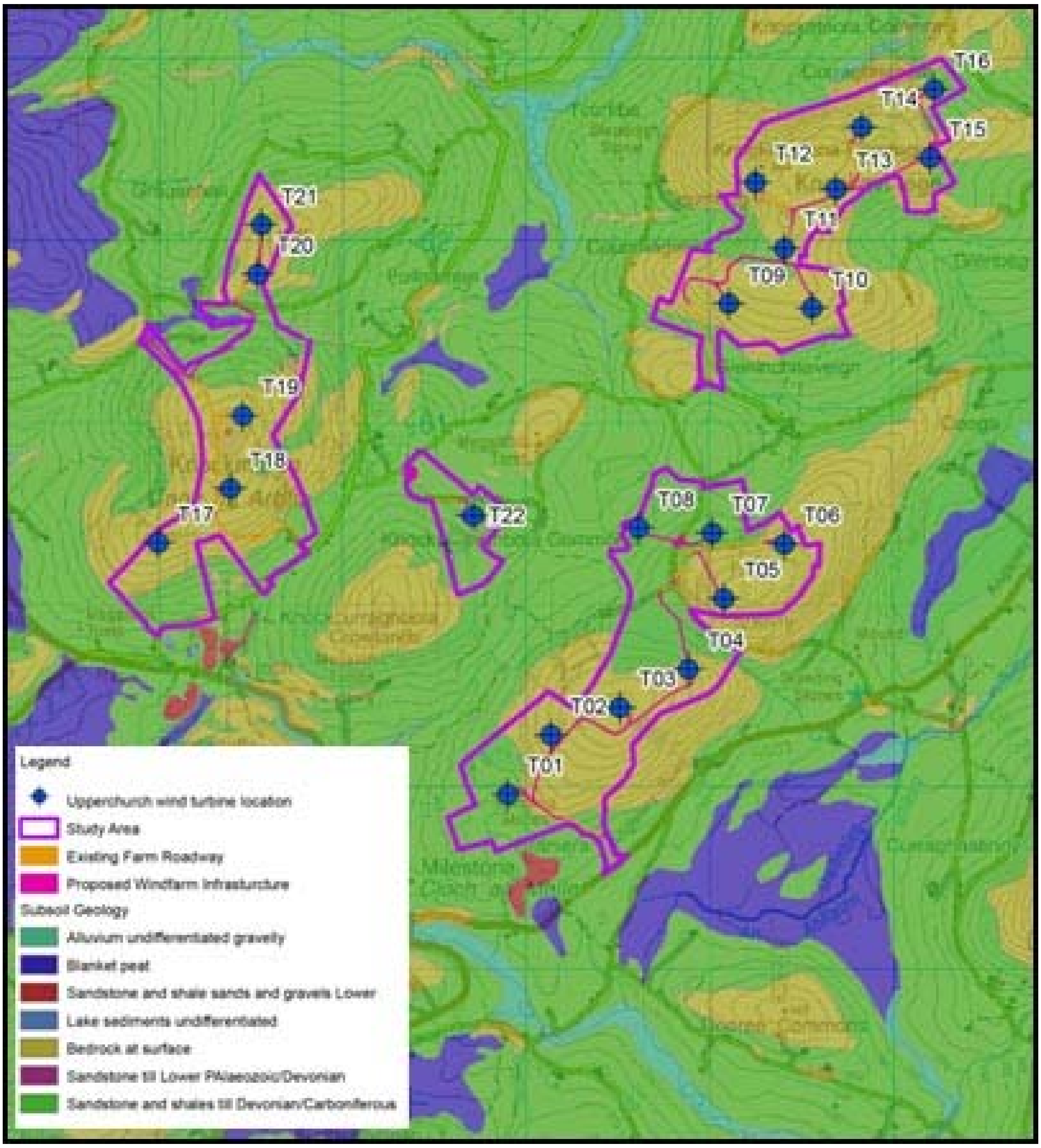


FIGURE 14-3: SOIL GEOLOGY

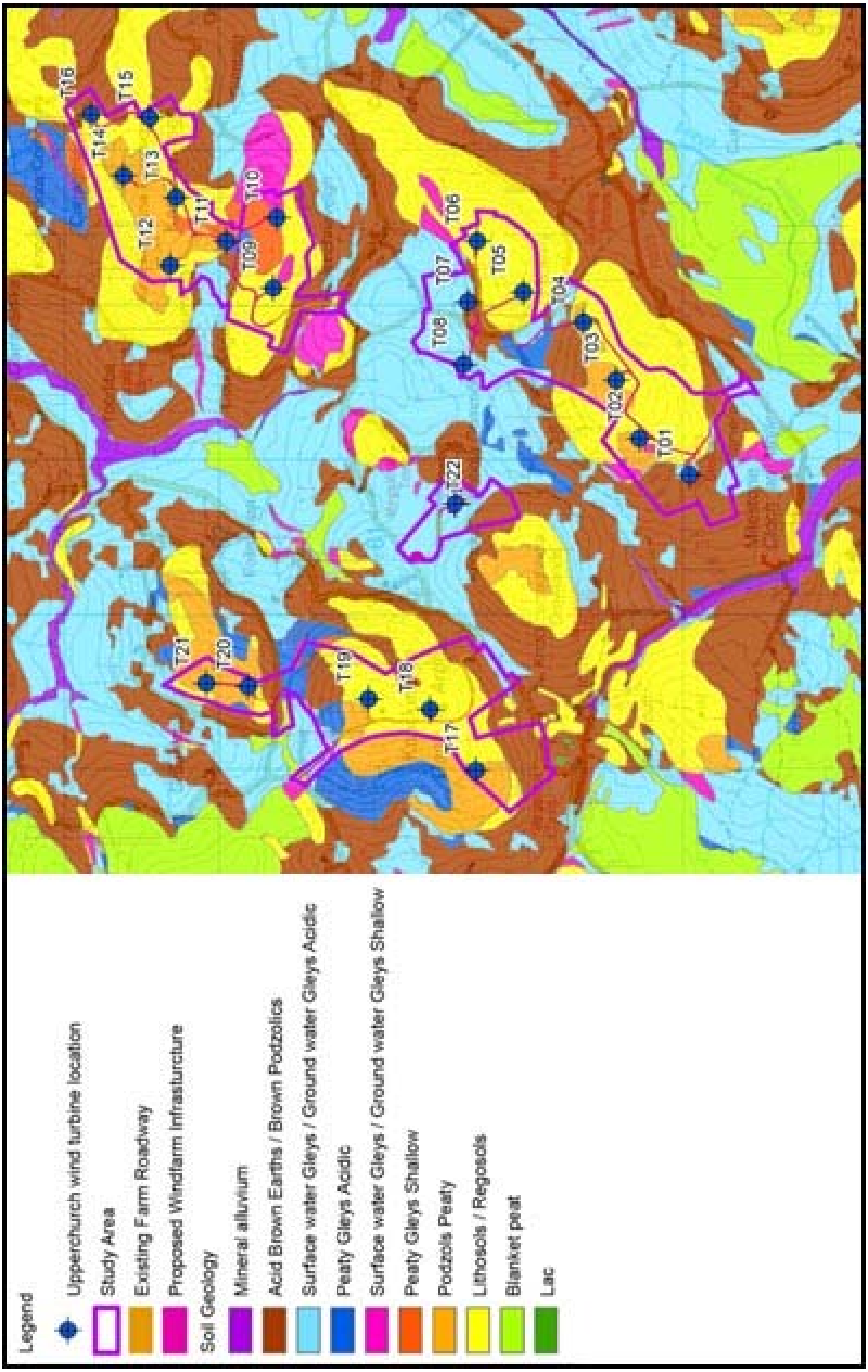


FIGURE 14-4: CORINE LAND COVER

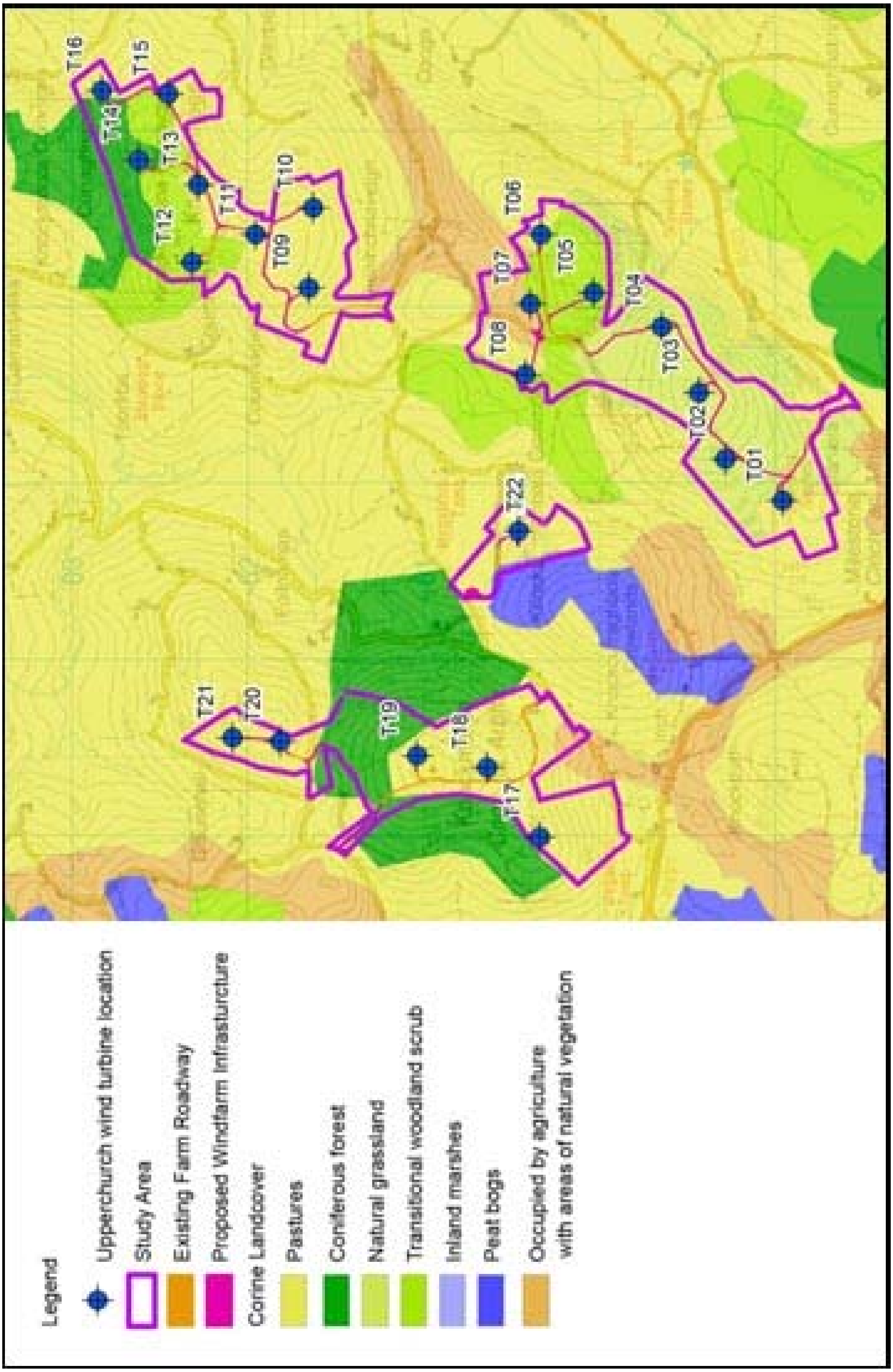


FIGURE 14-5: QUARRY LOCATIONS

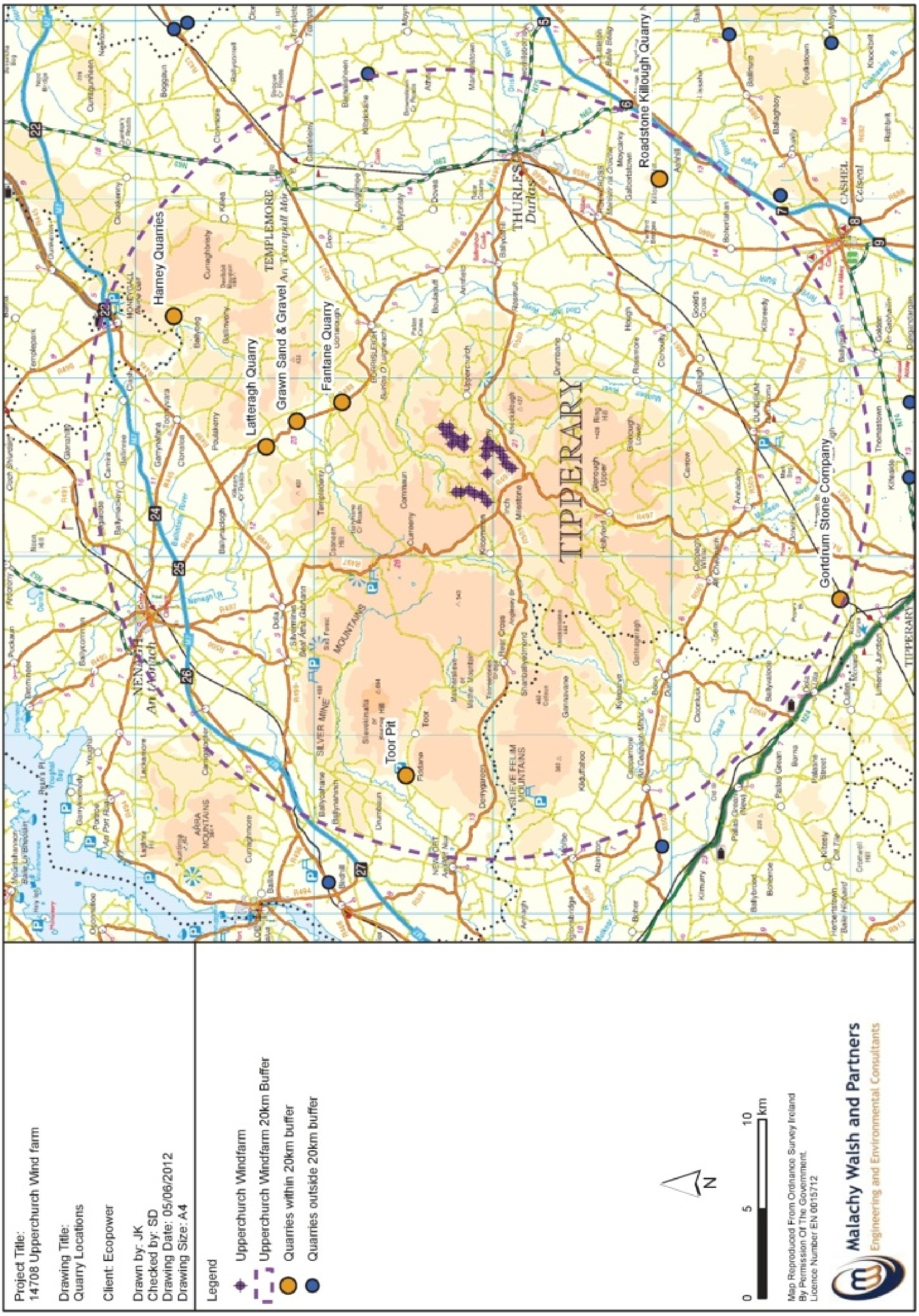
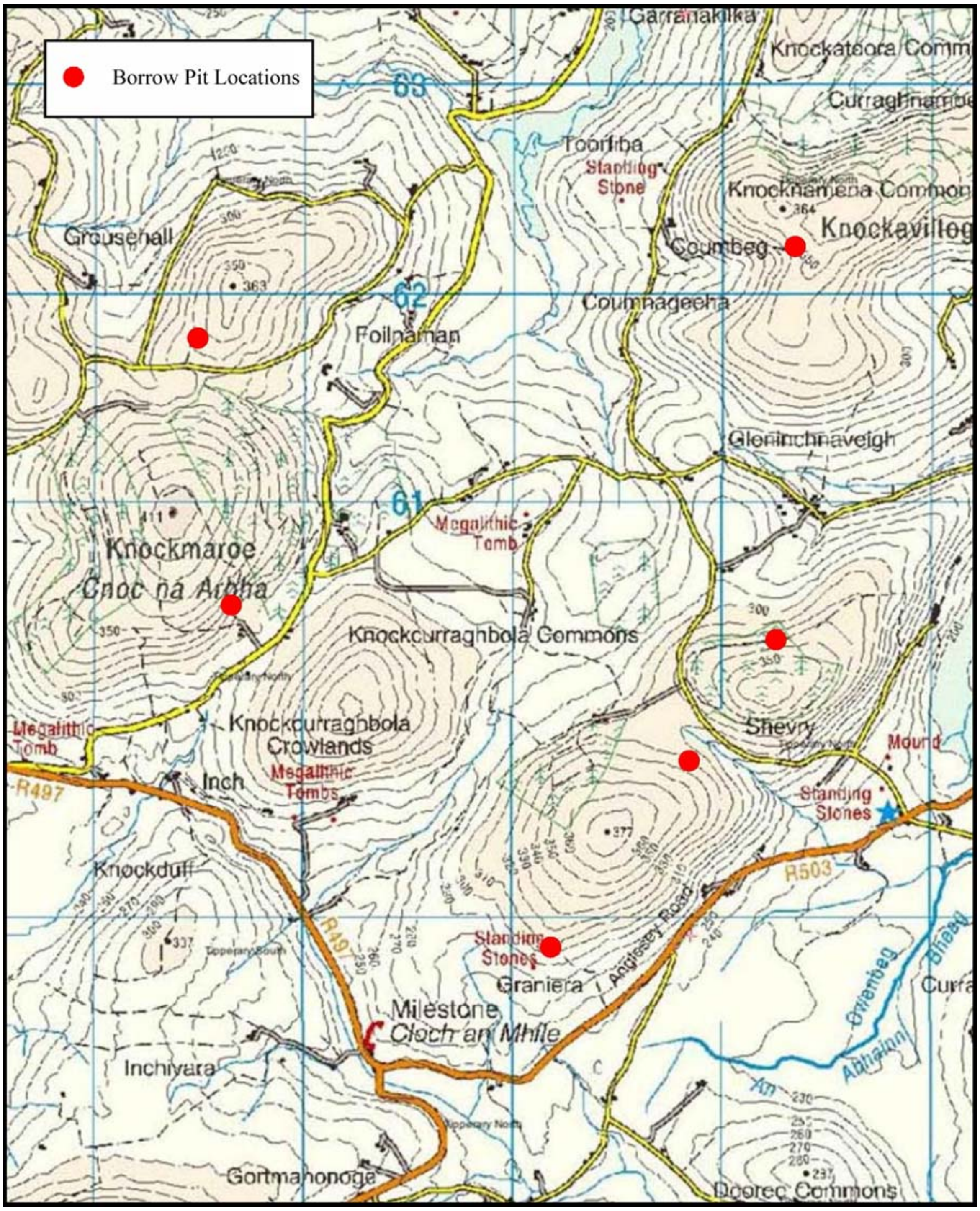


FIGURE 14-6: BORROW PIT LOCATIONS



APPENDIX 14-I TRIAL PIT LOGS AND PHOTOGRAPHS

Trial Pit Log

Project:	Wind Farm Development	**Trial Pit ID**			T01			
Location:	Upperchurch, Thurles, County Tipperary	**ING Coordinates**			E: 194902 N: 158932			
Client:	Ecopower Ltd., Sion Road, Kilkenny	**Elevation:**			unknown			
Date:	28 October 2011	**Logged by:**			S. Doyle			
					Samples /Tests			
Strata Description		**Depth (m)**	**OD level**	**Water depth**	**Type**	**Depth**	**Result**	
Organic soil		0.30						
Soft brown stony CLAY, stone size typically less than100mm		0.80						
Weathered SILTSTONE becoming more solid with depth		2.00						
End of trial pit at siltstone bedrock								

Remarks:
No groundwater encountered at 2m depth

Trial Pit Log

Project:	Wind Farm Development	**Trial Pit ID**	T02
Location:	Upperchurch, Thurles, County Tipperary	**ING Coordinates**	E: 195261 N: 159221
Client:	Ecopower Ltd., Sion Road, Kilkenny	**Elevation:**	unknown
Date:	28 October 2011	**Logged by:**	S. Doyle

Strata Description	**Depth (m)**	**OD level**	**Water depth**	**Samples /Tests** Type	Depth	Result
Organic soil	0.30					
Soft brown stony CLAY, stone size typically less than100mm	1.20					
Heavily weathered SILTSTONE	2.60					
End of trial pit at siltstone bedrock						

Remarks:
No groundwater encountered at 2.60m depth

T02 - Photograph 1

T02 - Photograph 2

T02 - Photograph 3

T02 - Photograph 4

Trial Pit Log

Project:	Wind Farm Development	**Trial Pit ID**	T03
Location:	Upperchurch, Thurles, County Tipperary	**ING Coordinates**	E: 195574 N: 159410
Client:	Ecopower Ltd., Sion Road, Kilkenny	**Elevation:**	unknown
Date:	28 October 2011	**Logged by:**	S. Doyle

Strata Description	**Depth (m)**	**OD level**	**Water depth**	**Samples /Tests** Type	Depth	Result
Organic soil	0.20					
Soft stony CLAY, progressively more stony with depth	1.80					
End of trial pit at SILTSTONE bedrock						

Remarks:
No groundwater encountered at 1.80m depth

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T03 - Photograph 1

T03 - Photograph 2

Trial Pit Log

Project:	Wind Farm Development	**Trial Pit ID**	T04			
Location:	Upperchurch, Thurles, County Tipperary	**ING Coordinates**	E: 195988 N: 159620			
Client:	Ecopower Ltd., Sion Road, Kilkenny	**Elevation:**	unknown			
Date:	28 October 2011	**Logged by:**	S. Doyle			

Strata Description	**Depth (m)**	**OD level**	**Water depth**	**Samples /Tests** Type	Depth	Result
Organic soil	0.20					
Soft light brown/orange CLAY	0.50					
Soft brown/grey stony CLAY	1.50					
Very loose weathered SILTSTONE (trial pit sides unstable)	2.90					
End of trial pit at solid siltstone						

Remarks:
No groundwater encountered at 2.90m depth
Clay sample taken

T04 - Photograph 1

T04 - Photograph 2

T04 - Photograph 3

T04 - Photograph 4

Trial Pit Log

Project:	Wind Farm Development	**Trial Pit ID**	T06				
Location:	Upperchurch, Thurles, County Tipperary	**ING Coordinates**	E: 196450 N: 160319				
Client:	Ecopower Ltd., Sion Road, Kilkenny	**Elevation:**	unknown				
Date:	28 October 2011	**Logged by:**	S. Doyle				

Strata Description	**Depth (m)**	**OD level**	**Water depth**	**Samples /Tests** Type	Depth	Result
Organic soil	0.20					
Loose brown stony CLAY	1.00					
Hard weathered SILTSTONE (progressively harder with depth)	2.30					
End of trial pit at siltstone bedrock						

Remarks:
No groundwater encountered at 2.30m depth

T06 - Photograph 1

T06 - Photograph 2

Trial Pit Log

Project:	Wind Farm Development	**Trial Pit ID**			T07			
Location:	Upperchurch, Thurles, County Tipperary	**ING Coordinates**			E: 195989 N: 160428			
Client:	Ecopower Ltd., Sion Road, Kilkenny	**Elevation:**			unknown			
Date:	11 April 2012	**Logged by:**			S. Doyle			
					Samples /Tests			
Strata Description		**Depth (m)**	**OD level**	**Water depth**	**Type**	**Depth**	**Result**	
Organic soil		0.15						
Soft grey CLAY with some organic content		0.45						
Stiff stony grey CLAY		1.00						
Stiff stony yellow CLAY		2.70						
End of trial pit within clay stratum								

Remarks:
Clay is very dry.
No water in excavation.

T07 - Photograph 1

T07 - Photograph 2

Trial Pit Log

Project:	Wind Farm Development			**Trial Pit ID**		T08		
Location:	Upperchurch, Thurles, County Tipperary			**ING Coordinates**		E: 195598 N: 160397		
Client:	Ecopower Ltd., Sion Road, Kilkenny			**Elevation:**		unknown		
Date:	11 April 2012			**Logged by:**		S. Doyle		
Strata Description		**Depth (m)**	**OD level**	**Water depth**		**Samples /Tests** Type	Depth	Result
Organic soil		0.15						
Soft grey CLAY with some organic content		0.45						
Soft stony grey CLAY		2.00						
End of trial pit at SILTSTONE bedrock								

Remarks:
Siltstone bedrock is very hard.
No water in excavation.

T08 - Photograph 1

T08 - Photograph 2

Trial Pit Log

Project:	Wind Farm Development	**Trial Pit ID**			T09			
Location:	Upperchurch, Thurles, County Tipperary	**ING Coordinates**			E: 196117 N: 161662			
Client:	Ecopower Ltd., Sion Road, Kilkenny	**Elevation:**			unknown			
Date:	11 April 2012	**Logged by:**			S. Doyle			
					Samples /Tests			
Strata Description		**Depth (m)**	**OD level**	**Water depth**	**Type**	**Depth**	**Result**	
Organic soil		0.15						
Soft stony yellow CLAY		1.70						
Weathered SHALE		2.00						
SHALE		2.80						
End of trial pit within shale stratum								

Remarks:
Shale rock is competent at 2.00m depth below the surface.
No water in excavation.

T09 - Photograph 1

T09 - Photograph 2

Trial Pit Log

Project:	Wind Farm Development	**Trial Pit ID**	T10
Location:	Upperchurch, Thurles, County Tipperary	**ING Coordinates**	E: 196539 N: 161601
Client:	Ecopower Ltd., Sion Road, Kilkenny	**Elevation:**	unknown
Date:	11 April 2012	**Logged by:**	S. Doyle

Strata Description	**Depth (m)**	**OD level**	**Water depth**	**Samples /Tests** Type	Depth	Result
Organic soil	0.20					
Soft stony yellow CLAY	1.00					
Weathered SILTSTONE	1.80					
End of trial pit at siltstone bedrock						

Remarks:
Siltstone bedrock is very hard.
No water in excavation.

T10 - Photograph 1

T10 - Photograph 2

Trial Pit Log

Project:	Wind Farm Development	**Trial Pit ID**	T11				
Location:	Upperchurch, Thurles, County Tipperary	**ING Coordinates**	E: 196417 N: 161965				
Client:	Ecopower Ltd., Sion Road, Kilkenny	**Elevation:**	Unknown				
Date:	11 April 2012	**Logged by:**	S. Doyle				

Strata Description	**Depth (m)**	**OD level**	**Water depth**	**Samples /Tests** Type	Depth	Result
Organic soil	0.30					
	0.80					
Weathered SILTSTONE	1.70					
End of trial pit at siltstone bedrock						

Remarks:
No water in excavation.

T11 - Photograph 1

T11 - Photograph 2

Trial Pit Log

Project:	Wind Farm Development	**Trial Pit ID**	T12
Location:	Upperchurch, Thurles, County Tipperary	**ING Coordinates**	E: 196253 N: 162314
Client:	Ecopower Ltd., Sion Road, Kilkenny	**Elevation:**	unknown
Date:	11 April 2012	**Logged by:**	S. Doyle

Strata Description	**Depth (m)**	**OD level**	**Water depth**	**Samples /Tests** Type	Depth	Result
Organic soil	0.20					
Soft brown CLAY	1.20					
Weathered SHALE	3.00					

Remarks:
Shale rock is competent at 2.00m below the surface.
No water in excavation.

T12 - Photograph 1

T12 - Photograph 2

T12 - Photograph 3

Trial Pit Log

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Project:	Wind Farm Development			**Trial Pit ID**	T13	
Location:	Upperchurch, Thurles, County Tipperary			**ING Coordinates**	E: 196716 N: 162269	
Client:	Ecopower Ltd., Sion Road, Kilkenny			**Elevation:**	unknown	
Date:	11 April 2012			**Logged by:**	S. Doyle	

Strata Description	**Depth (m)**	**OD level**	**Water depth**	**Samples /Tests** Type	Depth	Result
Organic soil	0.15					
Soft stony yellow CLAY	0.70					
Weathered SILTSTONE	1.60					
End of trial pit at siltstone bedrock						

Remarks:
No water in excavation

T13 - Photograph 1

T13 - Photograph 2

Trial Pit Log

Project:	Wind Farm Development	**Trial Pit ID**			T15			
Location:	Upperchurch, Thurles, County Tipperary	**ING Coordinates**			E: 197132 N: 162393			
Client:	Ecopower Ltd., Sion Road, Kilkenny	**Elevation:**			unknown			
Date:	11 April 2012	**Logged by:**			S. Doyle			
					Samples /Tests			
Strata Description		**Depth (m)**	**OD level**	**Water depth**	**Type**	**Depth**	**Result**	
Organic soil		0.15						
Soft brown/yellow CLAY		1.10						
Weathered SILTSTONE		2.10						
End of trial pit at siltstone bedrock								

Remarks:
Siltstone bedrock is very hard.
No water in excavation.

T15 - Photograph 1

T15 - Photograph 2

Trial Pit Log

Project:	Wind Farm Development	**Trial Pit ID**	T16
Location:	Upperchurch, Thurles, County Tipperary	**ING Coordinates**	E: 197224 N: 162824
Client:	Ecopower Ltd., Sion Road, Kilkenny	**Elevation:**	unknown
Date:	10 May 2012	**Logged by:**	S. Doyle

Strata Description	**Depth (m)**	**OD level**	**Water depth**	**Samples /Tests** Type	Depth	Result
Organic soil	0.15					
Soft grey CLAY	0.60					
Soft yellow CLAY	1.60					
Weathered SHALE	2.60					
End of excavation at SILTSTONE bedrock						

Remarks:
No groundwater encountered.

T16 - Photograph 1

T16 - Photograph 2

Trial Pit Log

Project:	Wind Farm Development	**Trial Pit ID**	T17				
Location:	Upperchurch, Thurles, County Tipperary	**ING Coordinates**	E: 193559 N: 162081				
Client:	Ecopower Ltd., Sion Road, Kilkenny	**Elevation:**	unknown				
Date:	12 April 2012	**Logged by:**	S. Doyle				
					Samples /Tests		
Strata Description		**Depth (m)**	**OD level**	**Water depth**	**Type**	**Depth**	**Result**
Organic PEAT		0.10					
Soft yellow stony CLAY		0.40					
Weathered SILTSTONE with some clay content		1.20					
End of trial pit at siltstone bedrock							

Remarks:
No groundwater encountered.

T17 - Photograph 1

T17 - Photograph 2

Trial Pit Log

Project:	Wind Farm Development	**Trial Pit ID**			T18			
Location:	Upperchurch, Thurles, County Tipperary	**ING Coordinates**			E: 193534 N: 161809			
Client:	Ecopower Ltd., Sion Road, Kilkenny	**Elevation:**			unknown			
Date:	12 April 2012	**Logged by:**			S. Doyle			
					Samples /Tests			
Strata Description		**Depth (m)**	**OD level**	**Water depth**	**Type**	**Depth**	**Result**	
Organic soil		0.15						
Soft orange/yellow CLAY		0.45						
Soft stony yellow CLAY with angular cobbles		1.40						
Weathered SILTSTONE with some clay content		2.20						
End of trial pit at siltstone bedrock								

Remarks:
Minor ingress of groundwater into the excavation after 20 minutes.

T18 - Photograph 1

T18 - Photograph 2

Trial Pit Log

Project:	Wind Farm Development	**Trial Pit ID**	T19
Location:	Upperchurch, Thurles, County Tipperary	**ING Coordinates**	E: 193430 N: 161039
Client:	Ecopower Ltd., Sion Road, Kilkenny	**Elevation:**	unknown
Date:	12 April 2012	**Logged by:**	S. Doyle

Strata Description	Depth (m)	OD level	Water depth	Samples /Tests: Type	Samples /Tests: Depth	Samples /Tests: Result
Organic soil	0.15					
Soft yellow stony CLAY	1.10					
Weathered SILTSTONE	1.70					
End of trial pit at siltstone bedrock						

Remarks:
Siltstone is hard at 1.70m below the surface.
No groundwater infiltration.

T19 - Photograph 1

T19 - Photograph 2

Trial Pit Log

Project:	Wind Farm Development	**Trial Pit ID**	T20
Location:	Upperchurch, Thurles, County Tipperary	**ING Coordinates**	E: 193367 N: 160612
Client:	Ecopower Ltd., Sion Road, Kilkenny	**Elevation:**	unknown
Date:	12 April 2012	**Logged by:**	S. Doyle

Strata Description	**Depth (m)**	**OD level**	**Water depth**	**Samples /Tests** Type	Depth	Result
Organic soil	0.15					
Soft yellow stony CLAY	1.10					
Weathered SILTSTONE	1.70					
End of trial pit at siltstone bedrock						

Remarks:
Siltstone is hard at 1.70m below the surface.
No groundwater infiltration.

T20 - Photograph 1

T20 - Photograph 2

Trial Pit Log

Project:	Wind Farm Development	**Trial Pit ID**	T21		
Location:	Upperchurch, Thurles, County Tipperary	**ING Coordinates**	E: 192992 N: 160336		
Client:	Ecopower Ltd., Sion Road, Kilkenny	**Elevation:**	unknown		
Date:	10 May 2012	**Logged by:**	S. Doyle		

Strata Description	**Depth (m)**	**OD level**	**Water depth**	**Samples /Tests** Type	Depth	Result
Organic soil	0.15					
Soft brown CLAY	0.45					
Heavily weathered SILTSTONE	1.50					
End of trial pit at siltstone bedrock						

Remarks:
Siltstone is hard at 1.50m below the surface.
No groundwater infiltration.

T21 - Photograph 1

T21 - Photograph 2

Trial Pit Log

Project:	Wind Farm Development	**Trial Pit ID**			T22		
Location:	Upperchurch, Thurles, County Tipperary	**ING Coordinates**			E: 194754 N: 160387		
Client:	Ecopower Ltd., Sion Road, Kilkenny	**Elevation:**			unknown		
Date:	12 April 2012	**Logged by:**			S. Doyle		
					Samples /Tests		
Strata Description		**Depth (m)**	**OD level**	**Water depth**	**Type**	**Depth**	**Result**
Peaty organic soil		0.30					
Stiff stony grey CLAY		1.50					
Stiff stony yellow CLAY		2.20					
End of trial pit within clay stratum							

Remarks:
No groundwater infiltration.

T22 - Photograph 1

T22 - Photograph 2

Malachy Walsh and Partners

Consulting Engineers

Cork | Tralee | Limerick | London

WINDFARM DEVELOPMENT

UPPERCHURCH, THURLES, COUNTY TIPPERARY

HYDROLOGICAL IMPACT ASSESSMENT

ECOPOWER DEVELOPMENTS LIMITED

Project	Document	Revision	Prepared	Checked	Status	Date
14708	6004	B	Sean Doyle	Jack O'Leary	Final	17 September 2012

15 Hydrological Impact Assessment

15.1 INTRODUCTION

It is proposed to construct a 22 turbine wind farm in the area immediately to the west of Upperchurch and 18km to the west of Thurles, County Tipperary. The turbines, which are numbered T01 to T22 are arranged in four clusters within an overall area of 12km^2.

The four clusters are as follows

- T01 to T08 are arranged around two hills at Shevry;
- T09 to T16 are arranged around the hill at Knocknameana Commons;
- T17 to T21 are arranged around two hills at Knockmaroe and Foilnaman;
- T22 is a single turbine on the northeast side of the hill at Knockcurraghbola Crowlands.

This study describes the existing hydrological characteristics at the proposed wind farm site. The surface water features and characteristics are described, as well as the site drainage and groundwater. An impact assessment was carried out to determine whether the project poses a significant impact to the hydrology and hydrogeological aspects of the environment and to propose mitigation measures to reduce any potential negative impact of the proposed wind farm.

15.1.1 Scope of assessment

The following sets out the scope of the assessment undertaken:

- Establish the baseline conditions on site;
- Identify the impacts of the proposed development during construction and operation of the project;
- Develop mitigation measures to reduce or eliminate the impacts;
- Identify any residual impacts after mitigation measures are implemented.

15.1.2 Consultation

The GSI and EPA databases were consulted in terms of classifying the aquifers underlying the region and to establish sensitive or important aquifers. The aquifer location, importance and position relative to the proposed site are discussed in the report.

15.1.3 Desk study

The desk study involved a review of all available information, datasets and documentation sources pertaining to the site's natural environment and involved the following:

- Examination of maps and aerial photography;
- Review of legislation including the Water Framework Directive and all previous water quality legislation;

- Review of the South Eastern River Basin Management Plan (2009 – 2015);
- Review of the Suir Main Water Management Unit Action Plan. This is the primary river in the catchment and ultimately receives the water from the greater proportion of the proposed site;
- Review of the Shannon International River Basin Management Plan (2009 – 2015). The Shannon is the primary river in the catchment for part of the southwest section of the proposed site;
- Review of existing water quality data, chemical and biological, available from EPA etc.;
- Review of Water Framework Directive datasets, reports and maps;
- Examination of maps and aerial photography to identify any hydrological features and site topography and slope;
- Determination of the catchments and drainage regime on and downstream from the site;
- Examination of the Geological Survey of Ireland (GSI) online datasets pertaining to hydro-geology features such as aquifers, wells, groundwater bodies and groundwater protection schemes;
- Examination of National Parks and Wildlife Service (NPWS) nature conservation designations;
- Preparation of catchment and other site maps and sampling field sheets for the site survey.

15.1.4 Site Walkover and Investigations

Field work included initial site walkovers and surveys followed by detailed site investigations and included the following:

- Site investigations in the form of peat probing and trial pits were undertaken at various times in October 2011 and in April and May 2012. Trial pits were excavated at 20 of the proposed turbine sites and peat depth and classification was measured at the remaining three sites (T05 & T14) which are in forested areas;
- Ground surface slope was measured at all turbine sites;
- A walkover survey of the site to identify hydrological features on site, wet ground, drainage patterns and distribution, exposures, drains etc.;
- Confirmation of the site catchments and drainage regime, and any hydrological buffers to be implemented;
- Field hydrochemistry measurements in-situ, using the YSI multi-parameter probe, to determine pH, Total Dissolved Solids, Electrical Conductivity, Dissolved Oxygen, Temperature;
- The collection of water samples for laboratory analysis for select quality parameters (Suspended Solids, Nitrate, mg/L NO3-N, Nitrite, mg/L NO2-N, MRP, mg/L, Alumimium mg/l, Phosphorous);
- Other parameters: MRP, PH, Econd, TDS, Nitrate, Nitrite, Suplhur; and
- Aquatic Ecology Assessment to determine biological Q-rating at chosen locations downstream of the site.

Following field surveys, the results were input to a standard GIS database. This allowed for accurate graphical representation of results.

This Hydrology and Hydrogeology Chapter integrates with the Sediment and Erosion Control Plan for the proposed site. This is included in **Appendix 15-I**.

15.1.5 Assessment Criteria

The results of the water sampling and analysis both in the field and in the laboratory are compared to Environmental Water Quality Standards as set out in the in the European Communities (Quality of Surface Water Intended for the Abstraction of Drinking Water) Regulations 1989. It must be noted that these standards are used for comparative purposes only as the surface water is not for human consumption.

The results have also been assessed against the surface water limits as outlined in S.I No. 293/1988- European Communities (Quality of Salmonid Waters) Regulations, 1988.

All water quality analysis must be considered in the wider context of the Water Framework Directive.

15.1.6 Legislation Context

15.1.6.1 The Water Framework Directive

The Water Framework Directive (WFD) (2000/60/EC) establishes an integrated and coordinated framework for the sustainable management of water. The Water Framework Directive, transposed into national legislation in 2003, aims to:

- Prevent deterioration of status for surface and groundwaters and the protection, enhancement and restoration of all water bodies;
- Achieve [1]good ecological status by 2015 and good chemical status for surface waters and good chemical and good quantitative status for groundwaters;
- Progresse reduction of pollution of priority substances and phase-out of priority hazardous substances in surface waters and prevention and limitation of input of pollutants in groundwaters;
- Reverse any significant upward trend of pollutants in groundwaters; and
- Achieve standards and objectives set for protected areas in Community legislation.

[1] Assessment of quality is based on the extent of deviation from these reference conditions, following the definitions in the Directive. 'Good status' means 'slight' deviation, 'moderate status' means 'moderate' deviation, and so on. The definition of ecological status takes into account specific aspects of the biological quality elements, for example "composition and abundance of aquatic flora" or "composition, abundance and age structure of fish fauna" (see WFD Annex V Section 1.1 for expanded definitions and a complete list).

The objective for each surface water body is to prevent deterioration, maintain high and good status waters, restore waters to at least good status by 2015 where necessary, and ensure that the requirements of associated protected areas are met. The WFD has at its core a series of River Basin Management Plans (RBMPs). The RBMPs were completed in 2009 and were adopted by the various local authorities in 2010. The proposed development is located primarily within the South Eastern River Basin District with a small part of the south western portion of the site being located in the Shannon River Basin District.

15.1.6.2 Environmental Quality Standards (EQS)

Environmental quality standards (EQS) for water quality were assessed against surface water limits set out in the European Communities (Quality of Surface Water Intended for the Abstraction of Drinking Water) Regulations 1989. The results have also been assessed against the surface water limits as outlined in S.I No. 293/1988 - European Communities (Quality of Salmonid Waters) Regulations, 1988.

15.1.7 Evaluation and impact assessment categorisation

The assessment was prepared with regard to the NRA Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydro-geology for National Road Schemes. The method of impact assessment and prediction follows the EPA (2002) Guidelines on the information to be contained in Environmental Impact Statements.

15.1.8 Constraint study and mitigation by avoidance

A key element of EIA is the avoidance and reduction of negative impacts at the design stage. Maximum use of existing infrastructure will be made, particularly access tracks. The final design has been informed by a constraints study which identified and included 50m buffer zones on all streams and rivers within and adjacent to the site where no infrastructure is proposed. See **Figure 15-6** at the end of this chapter.

For more detailed information on constraints refer to **Chapter 13 – Ecological Impact Assessment**.

15.2 EXISTING ENVIRONMENT

The hydrological environment includes all surface waters and hydrogeology and therefore includes all surface water catchments at the proposedUpperchurch wind farm site as well as the groundwater resource in the area.

15.2.1 Topography and land use

The proposal is to construct 22 wind turbines and a control building together with new and upgraded service roadways. Construction and operational access will be gained from the existing public Local road network via Regional roads R497 and R503 to the east and west of Milestone Cross. Electricity generated will be cabled underground to the wind farm control building, which will be located 305m southeast of turbine T18.

The site is divided into four separate clusters located around a number of hilltops to the west of Upperchurch village. The hills are at elevations of between 363mOD and 411mOD and the peaks are generally at heights of 100m above the intervening lower terrain. The principal land uses are agriculture with some commercial forestry.

The Slievefelim to Silvermines Mountains SPA lies to the west of the site.

The soil type varies considerably throughout the site but consists mainly of Lithosols / Rogosols, Surface water Gleys / Ground water Gleys, and Acid Brown Earths / Brown Podzolics. The hilltop areas include Peaty Podzolic soils and Peaty Gley soils.

There is a number of existing wind farms in the area surrounding the proposed Upperchurch wind farm. Table 15-1 below lists the wind farms within 15km of the site that have received planning permission or extensions of planning permission within the last 5 years or are under construction or in operation.

Wind farm	Number of Turbines	Distance and direction from proposed site	Status
Knockastanna, Co Limerick	4	8.1km south	Operating
Mienvee	1	9.0km southwest	Operating
Garracummer	15	3.5km southwest	In Construction
Falleennafinoga	2	5.5km south	In Construction
Hollyford	3	5.5km south	Permitted
Glencarbry	9	6.3km south	Permitted
Glenough	14	3.2km south	Operating
Cappagh White	18	8.5km south	Permitted
Curraghgraigue	6	9.5km north	Operating
Knockmeale	2	8.2km northwest	Permitted

TABLE 15-1 EXISTING AND PERMITTED WIND FARMS IN THE AREA

15.2.2 Hydrology

15.2.2.1 Surface Water and Drainage

The proposed site drains into streams that form the upper reaches of the Turraheen, Owenbeg, Clodiagh and Aughvana Rivers. The first three of these rivers form part of the South Eastern River Basin District and ultimately join the River Suir to the southeast. The Aughvana River, which forms part of the Shannon River Basin District, joins the Mulkear River and ultimately flows into the River Shannon to the east of Limerick City.

There are some EPA sampling stations in the vicinity of the proposed site as follows:

- The nearest sampling station on the Clodiagh River is at a bridge to the north of Castlehill (ING coordinates E: 198173, N: 165027), 5km downstream of the site and 2.4km to the north of turbine T16.
- The nearest sampling station on the Turraheen River (ING coordinates E: 197600, N: 155900) is 4km downstream of the site and 4km to the southeast of turbine T01.
- The nearest sampling station on the Owenbeg River is at a bridge on the local road immediately to the south of the R503 at Upperchurch (ING coordinates E: 198577, N: 160362) and 2.2km to the east of turbine T06.

The site drains to the different rivers as follows:

- The area around turbines T01 and T02 drains towards the west to an unnamed tributary of the Turraheen River.
- The area around turbines T03, T04, T05 and T06 drains to the southeast to the Owenbeg River and its tributaries.
- The area around turbines T07, T08 and T09 drains to the north to the streams that form the upper reaches of the Clodiagh River.
- The area around turbines T10, T11, T13 and T15 drains to the south and southeast to tributaries of the Owenbeg River.
- The area around turbines T12, T14 and T16 drain to the west and north to the Clodiagh River.
- The area around turbines T17 and T18 drains south to an unnamed tributary of the Aughvana River. This is the only part of the overall site that forms part of the Shannon River Basin District.
- The remaining areas around turbines T19, T20, T21 and T22 drain in different directions to unnamed tributaries of the Clodiagh River to the north.

The locations of the sampling points are shown in Table 15-2 below and **Figure 15-2** at the end of this chapter.

Sampling Station	**Grid Reference (ING)**	**Location**
1	97973, 61082	Unnamed stream (east of site), flows to the Owenbeg River
2	97336, 59293	Owenbeg River (east of site)
3	94363, 59329	Unnamed stream (southern section of site), flows to Turraheen River

4	95056, 62330	Unnamed stream (central area of site), flows to the Clodiagh River
5	91623, 63001	Unnamed stream (north section of the site), flows to the Clodiagh River
6	93464 59759	Unnamed stream (southern section of site), flows to the Aughvana River

TABLE 15-2 WATER QUALITY SAMPLING POINT LOCATIONS

15.2.2.2 Water quality in the existing environment

Chemical and Biological analyses of water each have inherent advantages and disadvantages. Biological analysis can detect ecological change which will be indicative of water quality or pollution, but the chemical analysis is required to ascertain the root cause. However, hydrochemical sampling is a spot check analysis on water quality which can vary greatly due to site conditions and environmental factors at a particular time (e.g. time of day relating to temperature, presence of farm animals at stream prior to or at time of sampling). Surveys of the biological habitat (such as Q-rating surveys) provide a better depiction of the health of the baseline water environment.

WATER QUALITY

Water quality of the streams and water bodies within the study area was assessed in three ways, namely by means of field sampling (using a YSI handheld unit), physio-chemical analysis of water samples in a laboratory and also by means of Q sampling to assess biological standards. The use of combined assessment methods gives good indications of the standard of water quality as it exists today prior to any development.

Water chemistry and quality are a reflection of geology and land use and the main effects of pollution on quality are a reduction in oxygen and nutrient enrichment. The water quality assessments of surface waters within, adjacent to and downstream of the proposed development site are based on data collated from both physio-chemical and biological surveys.

The location of the field testing with the YSI unit and location of water sampling for laboratory analysis are shown in **Error! Reference source not found.** below. A discussion of the results is outlined in the following sections relative to each method of assessment.

Q SAMPLING METHODOLOGY

Biological water quality monitoring refers to Q Value system of ranges where the relationship between water quality and the in-stream macroinvertebrate community is described in numerical terms. A Q value of 5 indicates very high water quality while a Q value of 1 indicates poor water quality.

Biotic Index	EPA Water Quality	Water Framework Directive Ecological Status	Quality Status
Q5	Good	High	Unpolluted Waters
Q4-5	Fair - Good	High	
Q4	Fair	Good	
Q3-4	Doubtful - Fair	Moderate	Slightly Polluted Waters
Q3	Doubtful	Poor	Moderately Polluted

Q2-3	Poor - Doubtful	Poor	Waters
Q2	Poor	Bad	Seriously Polluted Waters
Q1-2	Bad - Poor	Bad	
Q1	Bad	Bad	

TABLE 15-3 RELATIONSHIP BETWEEN BIOTIC INDEX (Q-VALUE) AND WATER QUALITY.

Kick sampling, where the river bed is disturbed using the foot immediately upstream of a kick net, which collects the sample, was conducted at six sampling stations within the study area. Macroinvertebrate samples were returned to the laboratory where species within each kick sample were identified to genus level. Differing macroinvertebrate species are assigned to a group according to its tolerance of or sensitivity to water pollution. A river is then assigned a Q value based on these groupings.

The results of the Q sampling survey are shown in Tables 15-4 to 15-9 below.

Station number 1					
Date	11th June 2012	**DO%**	103.4	**Conductivity (µS)**	173
GPS Location (ING)	197973, 161082	**DO mg/L**	11.31	**pH**	7.5
GPS Accuracy	4m	**Temp (°C)**	11.28	**TDS (g/L)**	0.043

Bank Width	1.8m
Wet Width	1.5m
River Depth:	16.5cm
Velocity:	V. slow
Clarity :	Slightly turbid
Colour:	Slight
Dominant substrate:	Gravel & Mud
Filamentous Green Algae:	None
Macrophytes:	Normal growth
Sewage Fungus:	None
Siltation:	Heavy
Surrounding land type:	Pasture
Outflow pipes:	None
Shading:	Medium
Cattle Access:	Yes
Stream flow type:	Slow flow
Q value	Q3
Further comments	Depth of mud in areas up to 10cm. During time of sampling field to east closed for silage. Field to west wet grassland/no fencing Evidence of cattle encroachment. Geology- Silurian metasediments & volcanic with shallow peat top soil.

TABLE 15-4 RESULTS OF Q SAMPLING SURVEY, STATION NUMBER 1

Station number 2					
Date	11th June 2012	**DO%**	108.0	**Conductivity (µS)**	157
GPS Location (ING)	197336,1 59239	**DO mg/L**	11.64	**pH**	7.6
GPS Accuracy	4m	**Temp (°C)**	11.98	**TDS (g/L)**	0.33

Bank Width	1.9m- 2.0m
Wet Width	1.80m
River Depth:	Avg - 16.5c Max - 30cm
Velocity:	Fast
Clarity :	Clear
Colour:	Peat Stained/slight
Dominant substrate:	(Cobbles 65%) (Boulder 15%) sand/gravel
Filamentous Green Algae:	None
Macrophytes:	Normal growth
Sewage Fungus:	None
Surrounding land type:	To south Riparian Woodland/ to north improved grassland
Outflow pipes:	None
Shading:	Moderate
Cattle Access:	None
Stream flow type:	Riffle and glide
Q value	Q4
Bank Width	1.9m- 2.0m
Further comments	Slightly Peat stained water Field to north cattle grazing Species note: Brown trout, freshwater limpet. To immediate south WN5 with alder and salix

TABLE 15-5 RESULTS OF Q SAMPLING SURVEY, STATION NUMBER 2

Station number 3					
Date	11th June 2012	**DO%**	102.8	**Conductivity (µS)**	261
GPS Location (ING)	194363, 159329	**DO mg/L**	11.58	**pH**	7.2
GPS Accuracy	4m	**Temp (°C)**	10.03	**TDS (g/L)**	0.49

Bank Width	1.9m- 2.0m
Wet Width	1m
River Depth:	Avg - 12.5cm Max - 20cm
Velocity:	Fast
Clarity :	Clear
Colour:	Peat Stained/slight
Dominant substrate:	(Cobbles 40%) (Boulder 15%) sand/gravel
Filamentous Green Algae:	Trace
Macrophytes:	Normal growth
Sewage Fungus:	None
Surrounding land type:	To northwest improved wet grassland. Steep bank to south west then conifer plantation
Outflow pipes:	None
Shading:	Medium
Cattle Access:	Yes
Stream flow type:	Riffle and glide
Q value	Q4
Bank Width	1.9m- 2.0m
Further comments	Slightly Peat stained water. Field to northwest cattle grazing. To south east steep bank (5m) with narrow stretch of conifer plantation (Sitka spruce) 4 trees deep. Species note: Water starwort in pool areas (light cover)

TABLE 15-6 RESULTS OF Q SAMPLING SURVEY, STATION NUMBER 3

Station number 4					
Date	11th June 2012	**DO%**	104.3	**Conductivity (µS)**	188
GPS Location (ING)	195056, 162330	**DO mg/L**	11.15	**pH**	7.7
GPS Accuracy	4m	**Temp (°C)**	12.29	**TDS (g/L)**	0.29

Bank Width	2.0 - 2.30m
Wet Width	2.10m avg
River Depth:	Avg - 16.5cm Max - 30cm
Velocity:	Fast
Clarity :	Clear
Colour:	Peat Stained/slight
Dominant substrate:	(Cobbles 60%) (Boulder 10%) sand/gravel
Filamentous Green Algae:	Trace
Macrophytes:	Normal growth
Sewage Fungus:	None
Surrounding land type:	Pasture
Outflow pipes:	None
Shading:	medium
Cattle Access:	None
Stream flow type:	Riffle and glide
Q value	Q4
Bank Width	2.0 - 2.30m
Further comments	Fields to west saved for silage harvesting. Field to east recent cattle grazing wet grassland with areas of scrub. Geology- Silurian metasediments & volcanic. Soils mineral alluvium. Immediate bank areas very wet.

TABLE 15-7 RESULTS OF Q SAMPLING SURVEY, STATION NUMBER 4

Station number 5					
Date	11th June 2012	**DO%**	105.0	**Conductivity (μS)**	146
GPS Location (ING)	194623, 163001	**DO mg/L**	11.20	**pH**	7.6
GPS Accuracy	4m	**Temp (°C)**	12.45	**TDS (g/L)**	0.26

Bank Width	4- 4.4m
Wet Width	4.1m
River Depth:	Avg - 14.5cm Max - 25cm i
Velocity:	Fast
Clarity :	Clear
Colour:	Peat Stained/slight
Dominant substrate:	(Cobbles 55%) (Boulder 20%) sand/gravel
Filamentous Green Algae:	Trace
Macrophytes:	Normal growth
Sewage Fungus:	None
Surrounding land type:	Pasture to west/woodland N/NE
Outflow pipes:	None
Shading:	medium
Cattle Access:	yes
Stream flow type:	Riffle and glide
Sampled in minutes	Q4-5
Bank Width	4- 4.4m
Further comments	Slightly Peat stained Water. Animals were observed crossing river downstream of survey site. Species note: Very species diverse.

TABLE 15-8 RESULTS OF Q SAMPLING SURVEY, STATION NUMBER 5

Station number 6					
Date	22/08/2012	**DO%**	101.1	**Conductivity (µS)**	169
GPS Location	193464, 159759	**DO mg/L**	11.35	**pH**	7.6
GPS Accuracy	2m	**Temp (°C)**	12.10	**TDS (g/L)**	0.041
Bank Width	2.2m				
Wet Width	1.3m				
River Depth:	Avg 12cm; Max 20cm				
Velocity:	Fast				
Clarity :	Slightly turbid				
Colour:	Slight				
Dominant substrate:	Cobble50%; Gravel 20%; Boulder5% & fine gravel				
Filamentous Green Algae:	Trace				
Macrophytes:	Normal growth				
Sewage Fungus:	None				
Siltation:	Slight				
Surrounding land type:	Pasture				
Outflow pipes:	None				
Shading:	Medium				
Cattle Access:	Yes				
Stream flow type:	Riffle/Glide				
Sampled in minutes	*Stone wash*	1 minute	*Kick sampling*	2 minutes	
Further comments	During time of sampling field to east had recent cattle grazing. Field to west improved grassland/steep bank. No fencing on either bank. Evidence of cattle encroachment. Shading during time of survey was 25%. Further downstream on the west of R497 the stream in used as roadway. Geology- Silurian metasediments & volcanic with shallow peat top soil.				

TABLE 15-9 RESULTS OF Q SAMPLING SURVEY, STATION NUMBER 6

PHYSIOCHEMICAL WATER QUALITY

Physiochemical water quality testing was undertaken on the 11th of June and the 22 nd of August 2012 in order to establish the baseline water quality of watercourses just downstream of the proposed wind farm infrastructure catchment area. Testing was done at sampling stations on five streams outside the immediate site. Grab samples were collected at each location and sent to a laboratory for testing. The parameters tested included temperature, pH, electrical conductivity, total dissolved solids and dissolved oxygen and the results of the laboratory tests are contained in Table 15-9.

Parameter	**Site 1**	**Site 2**	**Site 3**	**Site 4**	**Site 5**	**Site 6**	**Salmonid Regulations S.I. No. 293 of 1988**	**Surface Water Regulations S.I. No. 272 of 2009**
pH	7.5	7.6	7.2	7.7	7.6	7.7	>6 & <9	
Alkalinity, mg/L as $CaCO_3$	72.5	62.9	91.1	81.0	56.6	119		
Temperature	11.28	11.98	10.03	12.29	12.46	12.10		
Suspended solids mg/L	3	2	6	<2	<2	18	<25	
BOD (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0	1.4	<5	<2.2
Nitrate(mg/L)NO_3-N	1.08	0.73	2.07	1.23	0.65	1.95		
Nitrite (mg/L)NO_2-N	<0.005	<0.005	<.005	<.005	<.005	0.01	<0.05	
Sulphate (mg/L)	5.14	4.85	5.70	4.78	4.56	4.36		
MRP, mg/L P	0.01	0.01	0.01	0.02	0.01	0.06		≤0.035
Total phosphorous P (mg/L)	0.09	<0.04	0.16	0.06	0.04	<0.04		
Total dissolved phosphorous P (mg/L)	0.09	<0.04	0.12	0.06	0.04	<0.04		
Particulate phosphorous (mg/L)	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04		
Ammonia	0.03	0.02	<0.02	0.03	0.02	<0.02	≤ 1	
Ammonia (unionised)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	≤ 0.02	
Metals								
Iron (mg/L)	0.251	0.146	0.025	0.089	0.110	0.16		
Aluminium (mg/L)	0.019	0.042	0.023	0.037	0.024	0.05		

TABLE 15-9 PHYSIOCHEMICAL WATER QUALITY RECORDED AT THE UPPERCHURCH SITE

Dissolved oxygen levels were good in all the watercourses that were surveyed (>11mg/L), indicating that all of the surface waters in the catchment areas had levels of oxygen present capable of supporting healthy salmonid populations as per the Salmonid Water Regulations (SI No. 293 of 1988) implementing the Freshwater Fish Directive (78/659/EEC).

Levels of unionised ammonia and nitrite that are known to be particularly toxic to fish were within the thresholds specified in the Salmonid Regulations (S.I. No. 293 of 1988) at <0.02 and <0.005 respectively (see Table 13-12). Similarly the BOD levels were low with sites 1 through 5 inclusive, recording <1.0mg/L BOD and site 6 recording the highest levels; 1.4mg/L BOD. All sites were in compliance with the Salmonid Water Regulations (see Table 13-12).

Ortho-phosphate (MRP) levels were similar across sampling sites with 0.01mg/L levels recorded at sites 1,2,3 and 5 with site 4 recording 0.2mg/L and site 6 recording the highest levels of 0.06mg/L. Sites 1 through 5 levels are below the levels recommended in the Surface Water Regulations (S.I. No. 272 of 2009) meeting the requirements of the regulation, however site 6 exceeds the ≤0.035 recommended levels.

The suspended solid levels were also very low for streams 1 through 5, with levels recorded at <2mg/l at sampling stations 4 and 5. Sampling station 2 recorded 2mg/L. Sampling stations 1 and 3 were slightly higher with levels of 3mg/L and 6mg/L respectively. Sampling station six recorded the highest levels of 18 mg/L. Sampling station 1 has a Q value of 3 with the other stations having values of 4 or 4/5. All streams were in compliance with the threshold of <25mg/l required under the Salmonid Water Regulations (S.I. No. 293 of 1988).

As the catchment is dominated by siliceous rocks the buffering capacity of water can change rapidly over the season especially when water levels are higher, resulting in the dilution of background mineral salts. As a result H+ ions are not easily neutralized, meaning a reduction in the pH. In addition, rain water that is naturally low in pH (circa 5.5) can scavenge acidic ions from pine needles and peat and wash them into receiving water bodies causing local reductions in pH. The pH levels at all sampling stations range between 7.2 and 7.7. These fall within the threshold (>6 & <9) required under the Salmonid Water Regulations (S.I. No. 293 of 1988), required for balanced and healthy fish populations in the Salmonid Regulations.

15.2.3 Hydrogeology

Groundwater is an important water source as it provides base-flow to rivers and surface water bodies and is a natural resource for human activities. It also has inherent value as a natural resource and warrants protection for the prevention of pollution and contamination. The Geological Survey of Ireland administers the Groundwater Protection Schemes within Ireland.

15.2.3.1 Aquifer classification at the site

Information on the underlying acquifer was acquired from consultation with the GSI databases.

The wind farm site lies entirely within the Templemore A groundwater body (GWB). This aquifer is classified as PI, Poor Aquifer – bedrock which is generally unproductive except for local zones.

The groundwater body extends from north of Templemore south towards Annacarthy in County Tipperary. The GWB contains the Silvermine Mountains, which lies within the South Eastern River Basin District. At the very north there is Kilduff Mountain, Devilsbit Mountain, Knockanora and Knocknascreggan. Elevations reach up to 450mOD at Hollyford. The land elevation drops off to the east of these mountains towards the Suir valley. Drainage is to the east towards the Suir valley.

The majority of groundwater flow in this aquifer is considered to take place in the upper weathered zone (3m), below this the amount of groundwater flow decreases gradually with depth and large flows are not expected below 10m except in isolated open fractures.

Groundwater will discharge locally to streams and rivers crossing the aquifer and also to small springs and seeps. Owing to the poor productivity of the aquifers in this body it is unlikely that any major groundwater-surface water interactions occur. Baseflow to rivers and streams is likely to be relatively low.

Diffuse recharge to this groundwater body occurs, mostly where subsoil is thinnest or most permeable. The proportion of available recharge that enters the groundwater body varies depending on the subsoil thickness and permeability. The steep slopes in this area will reduce the actual discharge by causing more interflow and overland flow.

Groundwater was not encountered in any of the trial pits that were excavated on the wind farm site.

The GSI Databases contains information on wells and boreholes in the area. Table 15-10 below shows the location, depth and use of boreholes within 2km of the site.

GSI Code	Coordinates (ING)	Location	Accuracy	Depth of Bore	Depth to Bedrock	Use
1715SEW036	E: 196380 N: 157650	Doree Commons, Upperchurch	50m	94.5m	Unknown	Agriculture & domestic
1715SEW042	E: 194310 N: 158390	Milestone, Upperchurch	50m	Unknown	Unknown	Agriculture and domestic
1715SEW044	E: 194930 N: 158390	Graneria Upperchurch	10-50m	Unknown	Unknown	Agriculture and domestic
1715SEW032	E: 193750 N: 159480	Knockcurrabola Crowlands, Upperchurch	10m	4m	Not met	Not recorded
1715SEW043	E: 196550 N: 159840	Shevry, Upperchurch	50m	76.2m	Unknown	Agriculture and domestic
1715SEW070	E: 191880 N: 160610	Reisk, Upperchurch	10m	4m	Not met	Not recorded
1715SEW064	E: 194330 N: 160660	Knockcurrabola Commons, Upperchurch	10m	4m	Not met	Not recorded
1715SEW108	E: 195690 N: 161220	Knockeravoola, Upperchurch	50m	91.4m	Unknown	Agriculture and domestic
1715SEW063	E: 195990 N: 161180	Knockamena Commons, Upperchurch	10m	2.5m	2.5m (presumed)	Not recorded
1715SEW062	E: 197210 N: 161120	Cooga, Upperchurch	10m	2.5m	2.5m	Not recorded
1715SEW069	E: 191440 N: 161420	Reisk, Upperchurch	10m	4m	2.5m (presumed)	Not recorded
1715SEW065	E: 194110 N: 161610	Foilnaman, Upperchurch	10m	3m	3m (presumed)	Not recorded
1715SEW109	E: 197100 N: 161680	Glenbeg, Upperchurch	50m	54.9m	Unknown	Not recorded
1715SEW061	E: 197560 N: 162080	Glenbeg, Upperchurch	10m	1.5m	1.5m	Not recorded
1715SEW060	E: 197810 N: 162310	Gortnada, Upperchurch	10m	2.5m	2.5m (presumed)	Not recorded
1715SEW101	E: 195780 N: 162320	Coumber, Upperchurch	50m	Unknown	Unknown	Agriculture and domestic
1715SEW103	E: 196000 N: 162500	Coumbeg, Upperchurch	50m	82.3m	Unknown	Agriculture and domestic
1715SEW119	E: 196020 N: 162800	Garrankilka, Upperchurch	20m	39.6m	6.1m	Agriculture and domestic
1715SEW066	E: 195120 N: 162990	Glastrigan Upperchurch	10m	3.3m	3.3m	Not recorded
1715SEW058	E: 197270 N: 163430	Seskin, Upperchurch	10m	4m	Not met	Not recorded
1715SEW057	E: 196380 N: 164040	Seskin, Upperchurch	10m	4m		Not recorded
1715SEW067	E: 193990 N: 164050	Cumme, Upperchurch	10m	3m	3m (presumed)	Not recorded

TABLE 15-10 RECORDED WELLS IN PROXIMITY TO THE SITE (GSI)

15.2.3.2 Groundwater protection

The GSI administers Groundwater Protection Schemes within Ireland and the scheme has been developed in conjunction with the Environmental Protection Agency and the Department of Environment, Heritage and Local Government. The Protection Schemes are based on a combination of factors, namely the details on the existing groundwater sources and resources and the vulnerability of the groundwater to pollution together with data regarding responses to groundwater protection.

15.2.3.3 Groundwater vulnerability

According to the GSI, groundwater vulnerability is a term used to represent the intrinsic geological and hydrogeological characteristics that determine the ease with which groundwater may be contaminated by human activities. The GSI uses a matrix comprising four groundwater vulnerability categories to classify aquifer vulnerability. These categories are extreme, high, moderate and low. The ratings are used in the GSI vulnerability Mapping Guidelines as outlined in Table 15-11 below.

Vulnerability Rating	Hydrogeological Conditions				
	Subsoil Permeability (Type) and Thickness			Unsaturated Zone	Karst Features
	High permeability (sand/gravel)	Moderate permeability (e.g. Sandy subsoil)	Low permeability (e.g. Clayey subsoil, clay, peat)	(Sand/gravel aquifers only)	(<30 m radius)
Extreme (E)	0 - 3.0m	0 - 3.0m	0 - 3.0m	0 - 3.0m	-
High (H)	> 3.0m	3.0 - 10.0m	3.0 - 5.0m	> 3.0m	N/A
Moderate (M)	N/A	> 10.0m	5.0 - 10.0m	N/A	N/A
Low (L)	N/A	N/A	> 10.0m	N/A	N/A

Notes: (1) N/A = not applicable.
(2) Precise permeability values cannot be given at present.
(3) Release point of contaminants is assumed to be 1-2 m below ground surface.

TABLE 15-11 VULNERABILITY MAPPING GUIDELINES

The Geological Survey of Ireland (GSI) Interim Vulnerability Classification maps indicate that the majority of the site is classified as *Extreme Vulnerability* (E) or *Extreme Vulnerability with rock near Surface or Karst* (X). This is in agreement with the site investigation results where rock was encountered at less than three metres depth in 18 out of 20 trial pits. The bedrock at the site is siltstone. **Figure 15-3**, at the end of this chapter, shows the GSI Interim Vulnerability Classification Map for the area.

Turbine T08 is in an area of High to Low Vulnerability (H/L). Turbines T01, T07 and T22 are in areas with vulnerability rating E and all the remaining turbines are in areas with vulnerability rating X. Almost all of the new roads and roads that are to be widened are in areas rated E or X.

15.2.3.4 Water balance

Water balance describes the flow of water into and out of the site. The low soil and subsoil permeability and significant ground surface slopes mean that there is limited capacity for rainwater to infiltrate the ground during periods of high rainfall. The land use at the site is mainly agricultural with some commercial forestry in the upland areas.

A water balance analysis has been undertaken to assess the likely run off volumes and flow for the site based on the ground type, permeability, contours and existing drainage network. This assessment has been used to identify how the proposed wind farm infrastructure will impact on the drainage patterns on site. This is then dealt with in the Sediment and Erosion Control Plan, which is included in **Appendix 15-I**, and informs the design of the drainage system on site.

15.2.3.5 Flood hazard

The OPW manages CFRAM programme, a catchment flood risk assessment and management programme, initiated in 2011 in response to the EU Floods Directive. The CFRAM Programme is central to the medium to long term strategy for the reduction and management of flood risk in Ireland. Implementation of the EU Floods Directive is coordinated with the Water Framework Directive and the River Basin Management Plans.

The OPW has completed a Preliminary Flood Risk Assessment (PFRA) for the country, the results of which are available online, via interactive mapping. The assessment considers all types of flooding that can occur, from rivers, sea, estuaries, heavy rain, groundwater and the failure of infrastructure. The PFRA identifies areas where the risk of flooding might be significant. The intent is to carry out more detailed study in these at risk areas to more accurately assess the degree and extent of flood risk.

The PFRA maps have been interrogated for the Upperchurch site and the results are indicated on the map in **Figure 15-4**: Preliminary Flood Risk Assessment Map (2019/MAP/150/A) at the end of this chapter.

Figure 15-4 indicates that none of the proposed infrastructure for the 22 turbines lies within any of the flood risk zones. Furthermore, the site drainage plan intends to attenuate any incidental rainfall on the new hard surfaces by means of silt fences, settling ponds and outfalls over land as opposed to direct discharge to watercourses. This will reduce the impact of the wind farm’s infrastructure on the downstream watercourses.

15.3 LIKELY SIGNIFICANT IMPACTS

The following sections provide an assessment of the unmitigated impacts of the proposed Upperchurch wind farm on the hydrological environment.

15.3.1 Characteristics of the proposal

The development is characterised by the following civil engineering works which will be undertaken to provide the necessary infrastructure to complete the wind farm:

- Excavation for the construction of 22 turbine bases with a minimum depth of 2.00m and 225m^2 plan area and hardstands with and excavation depth of 0.60m and 1,040m^2 plan area;
- Erection of 22 turbines with hub heights of up to 85m and maximum tip height of up to 126.60m;
- Construction of an electrical sub-station compound with excavation depth of 0.60m and 2,624m^2 plan area;
- Construction of 8.0km of 5.00m wide new roads;
- Widening and upgrading of 3.9km of existing farm roads (average 2m widening);
- Construction of a surface water drainage system along the road edges; and
- Importation of stone from local quarries for construction of access roads and hard standings.

The site layout is shown in **Figure 15-**1 at the end of this chapter.

15.3.2 Surface water flow

15.3.2.1 Interruption of existing drainage patterns

The existing drainage network on site, associated with wind farm tracks and natural streams has some potential to be impacted upon by the construction phase of the wind farm. Excavation of new drainage channels, and modifications to the existing surface water drainage network to link new infrastructure has the potential to impact on surface water flow. There is a potential for moderate negative impacts to occur to surface water flows.

15.3.2.2 Surface water quality

<u>RELEASE OF SUSPENDED SOLIDS</u>

The mains risks to water quality arise from the following;

- Release of suspended solids, particularly from peat soils;
- Nutrient release from transported or suspended sediments;
- Nutrient release from brash from tree felling to facilitate the works.

Suspended solids and nutrient release will have a negative impact on the water quality of streams/rivers and an impact on aquatic ecology (see **Chapter 13 Ecological Impact**

Assessment). Given the permeable nature of the existing soil and the small number of streams draining the site, the potential for a significant impact to surface water quality within the receiving catchments is low.

RISK OF POLLUTION FROM HYDROCARBON RELEASE

The construction of the wind farm infrastructure requires the use of mechanical plant and equipment. The use of plant on site introduces a risk of potential spillage of oils or hydrocarbons from vehicle and plant either working on site or delivering materials or equipment to site.

RISK OF POLLUTION FROM CEMENT

There is a risk of spillage and run off from cement trucks delivering concrete to site during the placing of concrete, but also in the washing out of chutes. The spillage of cementitous material into a watercourse would significantly impact on the pH of the water and thus impact on water quality.

RISK OF POLLUTION FROM WATER SANITATION

A risk of ground water pollution can occur where adequate toilet facilities are not provided on site.

RISK OF POLLUTION FROM TREE FELLING

In order to construct the proposed wind farm, felling of existing maturing conifer trees and clearing of young plantation will be required around turbines T05 and T14. The risk to water quality from felling comes from the brash and needles that remain from the felling process. Brash, if left on site, will eventually lose it needles and break down to effectively form a localised store of phosphorous. This has the potential to be released due to excavation and poor drainage controls.

In summary, there is a potential for minor-moderate negative impacts to occur to surface water quality due to tree felling.

15.3.2.3 Groundwater flow

EXCAVATION SEEPAGE

In terms of impact, limited and discontinuous seepage is expected from the sides of excavations for turbine pads in sloping ground. The excavations are likely to be up to 4m below ground level depending on the ground surface slope and formation depth. The time of year and level of rainfall for excavation will be a significant control in how much seepage occurs in foundations.

In the context of the site geology, its high elevation within the catchment combined with existing drainage, any seepage that does occur will be low in volume. Lowering of water table

The site investigations carried out on the site indicate that the water table levels are generally low. Excavation for turbine bases is therefore not likely to cause any lowering of the water table other than in the immediate vicinity of the bases.

DEWATERING OF WELLS

There are a number of wells in the area as listed in **Table 15-10 Recorded wells in proximity to the site (GSI)** above. Each of these wells is at a lower elevation than the proposed wind turbine locations or is separated from them by intervening valleys. There will therefore be no potential for dewatering or hydraulic impact on groundwater supplies.

15.3.2.4 Groundwater quality

GROUNDWATER CONTAMINATION

As outlined in Section 15.2.3.1 above, the wind farm site lies entirely within the Templemore A groundwater body. This aquifer is classified as PI, Poor Aquifer – bedrock which is generally unproductive except for local zones. Nonetheless, there are a number of wells in the area although the yields from them are not indicated in the GSI data for the area.

Due to the requirements of the Water Framework Directive with respect to the protection of all groundwater quality, the groundwater beneath the site requires preventative mitigation measures for potentially polluting activities, of which hydrocarbons release is the main threat to groundwater quality.

The potential threats to groundwater contamination are essentially the same for surface water and include the same potential sources. These are:

- Hydrocarbons from introduced plant equipment / fuel stations.
- Waste water and chemical treatment compounds from sanitation facilities.
- Inorganic nutrients such as nitrogen and phosphorus compounds from tree felling (if present in excavated sediment).

No wells have been identified within a distance of 100m of any of the proposed infrastructural works. The proposed development does not have the potential to pollute any known ground water supply.

15.3.3 Operational Phase

The potential impacts on the hydrological and hydrogeological environments during the operational phase are discussed hereunder.

15.3.3.1 Surface water flow

The construction of new roads, turbine bases and hardstands creates additional surface area from which increased surface water runoff can occur. On the proposed site there is a total of 8.0km of new wind farm roads, widening of 3.9km of existing roads, construction of 22 turbine bases and hard standing areas together with the associated new drainage works. The increase in impermeable area can increase the runoff rate to the downstream system.

15.3.3.2 Surface water quality

While the main threat to water quality, in particular surface water quality, arises during the construction phase of the project due to earthworks activity, there is also a risk of pollution during the early operation phase of the project that is associated with drainage runoff and release of suspended solids. The impact to surface water quality may be significant.

15.3.3.3 Groundwater quality

There is a potential risk of groundwater contamination during the operation phase of the project from maintenance vehicles. However, given the low level of maintenance required this risk is not considered significant.

15.4 MITIGATION MEASURES

15.4.1 Construction Phase

15.4.1.1 Mitigation by avoidance

A process of *'mitigation by avoidance'* was undertaken by the EIA team during the design of the turbine and associated infrastructure layout. Mitigation by avoidance was particularly relevant to avoiding, except at crossings, the local streams. Arising from the results of this study, a constraints map was produced which identifies areas where hydrological constraints make parts of the site unsuitable for development. A 50m constraints buffer was applied to all streams within the site during the project design phase. There will be no roads or turbine foundations within 50m of a watercourse, except at the necessary stream crossing. The internal road crosses streams at one location: 250m to the north of T04. See **Figure 15-6** at the end of this chapter.

15.4.1.2 Surface water flow

Potential impacts on site hydrology including surface water flow during construction phase of wind farm development are mitigated by the constructed drainage design. This will cause minimal disturbance to the current hydrological regime and will minimise suspended sediment loading. The details of this constructed drainage and associated drawings are outlined in the Sediment and Erosion Control Plan in **Appendix 15-I** at the end of this Chapter.

There will be no diversion, infilling or dewatering of existing surface water drainage as part of the proposed development; therefore no mitigation is required.

Where construction activities associated with the one watercourse crossings intercept the 50m hydrological buffer zone, the following mitigation will used to prevent any potential impacts:

- Construction activities in the hydrological buffer zones will be avoided during or after prolonged rainfall or an exceptional rainfall event. Work will cease entirely near watercourses when it is evident that pollution is likely to occur.
- Culverts will be installed at locations where land drains are intercepted and will be diverted into the clean water drains. The culverts will be designed to facilitate the large flows that may occur following intense or prolonged rainfall events.

All river and stream crossing method statements will be designed in consultation with Inland Fisheries Ireland – South Eastern River Basin District and Shannon River Basin District prior to initiation of construction works.

15.4.1.3 Surface water quality

<u>SEDIMENT AND EROSION CONTROL</u>

Erosion control where runoff is prevented from flowing across exposed ground and sediment control where runoff is slowed to allow suspended sediment to settle are important elements in runoff and sediment control. A Sediment and Erosion Control Plan has been prepared (See **Appendix 15-I** of this Chapter) and will be implemented to prevent sediment and pollutant runoff into the local watercourses during the construction phase. The plan includes the following elements:

- The plan will effectively consist of restoring and maintaining the existing drainage network and upgrading it as per new drainage details as required on site along the existing access track and roads where it exists and integrating it with newly constructed drainage required for upgraded and new roads.
- No work will take place within 50m buffer zones of watercourses, except at crossings.
- All construction method statements will be prepared in consultation with Inland Fisheries Ireland – South Eastern River Basin District and Shannon River Basin District.
- The area of exposed ground will be kept to a minimum by maintaining, where possible, existing vegetation.
- Temporary deposition areas will be designated and designed to hold temporary stockpiles and will be located away from drains and watercourses.
- Stockpiles that are at risk of erosion will be protected by silt trapping apparatus such as a geo-textile silt fence to prevent contaminated runoff.
- Silt fences or other appropriate silt retention measures will be installed where there is a risk of erosion runoff to watercourses from construction related activity, particularly during prolonged wet weather periods or following an intense rainfall event.
- The silt retention measures where they are installed will be inspected and maintained on a regular basis throughout the construction and operation phases of the wind farm.
- All associated tree felling will be undertaken using good working practices as outlined by the Forest Service in their 'Forestry Harvesting and Environment Guidelines' (Forest Service, 2000a) and the 'Forestry and Water Quality Guidelines '(Forest Service, 2000b). The latter guidelines deal with sensitive areas, erosion, buffer zone guidelines for aquatic zones, ground preparation and drainage, chemicals, fuel and machine oils.
- Drainage ditches or other suitable measures will be adopted alongside access roads, turbines and other disturbed areas to prevent silt or contamination from construction water runoff entering watercourses.
- Check dams will be placed at regular intervals based on slope gradient along all drains to slow down runoff so as to encourage settlement and to reduce scour and ditch erosion.
- Drains carrying construction site runoff will be diverted into silt traps.
- Wheel washes will be provided for exiting heavy vehicles to ensure roads outside of the site boundary are clean.
- Pumped or tremmied concrete will be monitored carefully to ensure no accidental discharge into local watercourses.
- A programme of inspection and maintenance of drainage and sediment control measures during construction will be designed and dedicated construction personnel assigned to manage this programme.
- Water quality monitoring will be carried out in years 1 and 2 of operation to determine whether water quality has been impacted. Monitoring of water quality parameters will

be conducted monthly in Year 1. If thresholds are not exceeded in Year 1, then the effort may be reduced in Year 2.

FUEL CONTROL

A fuel and oil management plan will be agreed with the civil contractor prior to commencement of construction. This will outline measures to prevent fuel and oil from entering local watercourses and emergency procedures to deal with any accidental spillages. See also Section 15.4.1.5 Groundwater quality below.

CEMENT CONTROL

During the pouring of concrete at the turbine bases effective containment measures will be implemented to avoid spilling concrete outside the construction area and prevent concrete entering the drainage system. In the case of cement washout entering water courses, the following measures will be put in place to mitigate and reduce its potential negative impact on water quality, particularly on baseline pH range:

- Trucks that deliver concrete to site will be washed out at the supplier's facilities and not on site.
- If the above is undertaken, this means that the only cement washing that will need to occur on site is the hand washing of the chutes at the rear of the cement lorries after the cement has been deposited.
- Run-off from wind turbine foundation concrete pours shall not be permitted to enter the watercourses and shall be contained within the foundation excavations and designated areas that are suitably sited and designed.
- In the case of emergencies there will be a dedicated concrete washout area onsite.

WASTE WATER SANITATION

During the construction phase, a self contained portable toilet with an integrated waste holding tank will be used on site for toilet facilities. This will be maintained by the service contractor on a regular basis and will be removed from the site on completion of the construction phase.

TREE FELLING

The impacts posed by the release of suspended solids and sedimentation after tree felling can be mitigated by following the requirements and mitigation measures outlined under *'Release of suspended solids'* in Section 15.3.2.2 - Surface water quality above. These measures include the protection of the riparian zones, installing buffered drainage outfalls, installation of drains and silt traps as soon as possible once felling has been completed, and a regime of continued monitoring of silt traps and drainage outfalls will be implemented.

Some tree felling (4.35 hA) will be required at turbines T05 and T14 for parts of the turbine foundation, hardstanding, under the swept area of the blades and for turbulence prevention. See **Figure 15-5: Clear Fell Areas Map** at the end of this chapter. All associated tree felling will be undertaken using good working practices as outlined by the Forest Service in their '*Forestry Harvesting and Environment Guidelines' (2000)* and the *'Forestry and Water Quality Guidelines ' (2000)*. The latter guidelines deal with sensitive areas, erosion, buffer zone guidelines for aquatic zones, ground preparation and drainage, chemicals, fuel and machine oils. All felled brash will be removed off site to avoid release and runoff of phosphorous into sensitive watercourses.

During the construction phase of the proposed project, water quality in the streams and outflow from end points of the drainage system will be monitored by sampling and testing on a regular basis during different weather conditions. This monitoring along with the visual monitoring outlined below will help to ensure that the mitigation measures that are in place to protect water quality are working.

15.4.1.4 Groundwater flow

<u>EXCAVATION SEEPAGE / INFLOWS</u>

Any water ingress that may be encountered in the weathered bedrock / mineral subsoils during the construction phase will be intercepted by an interceptor drain and diverted to the constructed drainage system for pollution control attenuation prior to discharge. All pumped water must be captured and directed to constructed drainage. No freshly pumped water must enter the existing drainage network directly or be pumped out onto adjacent habitat.

15.4.1.5 Groundwater quality

<u>GROUNDWATER CONTAMINATION</u>

The main threat to groundwater quality is the introduction of hydrocarbons to the site. In order to mitigate groundwater contamination by hydrocarbons in particular, it is proposed to implement a fuel management plan which should incorporate the following elements:

- Mobile bowsers, tanks and drums will be stored in secure, impermeable storage area, away from drains and open water;
- Fuel containers must be stored within a secondary containment system e.g. bund for static tanks or a drip tray for mobile stores;
- Ancillary equipment such as hoses, pipes must be contained within the bund;
- Taps, nozzles or valves must be fitted with a lock system;
- Fuel and oil stores including tanks and drums will be regularly inspected for leaks and signs of damage;
- Only designated trained operators will be authorised to refuel plant on site;
- Procedures and contingency plans will be set up to deal with emergency accidents or spills; and

- An emergency spill kit with oil boom, absorbers etc. is to be kept on site in the event of an accidental spill.

In relation to non-hydrocarbon potential contamination, waste water from temporary sanitation facilities will be mitigated by use of temporary and portable sanitary facilities that are self-contained. These facilities will not interact with the existing hydrological environment in any way and they will be maintained, serviced and removed from site at the end of the construction phase.

15.4.1.6 Environmental audits

Regular environmental water quality audits should take place during the construction phase to ensure compliance with legislative water quality standards and effective implementation of proposed mitigation measures.

15.4.2 Operational Phase

15.4.2.1 Surface water quality

The Sediment and Erosion Control Plan will be maintained for the early operational phase and replanting of vegetation should take place as necessary to minimise sediment loading. Regular environmental water quality audits should take place during the first two years of operation. Monitoring of water quality parameters will be conducted monthly in Year 1. If thresholds are not exceeded in Year 1, then the effort may be reduced in Year 2. Ongoing inspection and maintenance of the sediment and erosion measures will be carried out periodically throughout the life of the project.

15.5 CUMULATIVE IMPACTS

There is unlikely to be a significant cumulative impact on the hydrology and hydrogeology of the region if recommended mitigation measures are implemented.

15.6 RESIDUAL IMPACTS

The residual impact on the water environment during the construction and operational phase of the development is unlikely to be significant.

15.7 CONCLUSION

The development of the Upperchurch wind farm will not have a significant impact on Hydrology and Hydrogeology provided mitigation measures are implemented.

FIGURE 15 - 1: UPPERCHURCH WIND FARM LAYOUT

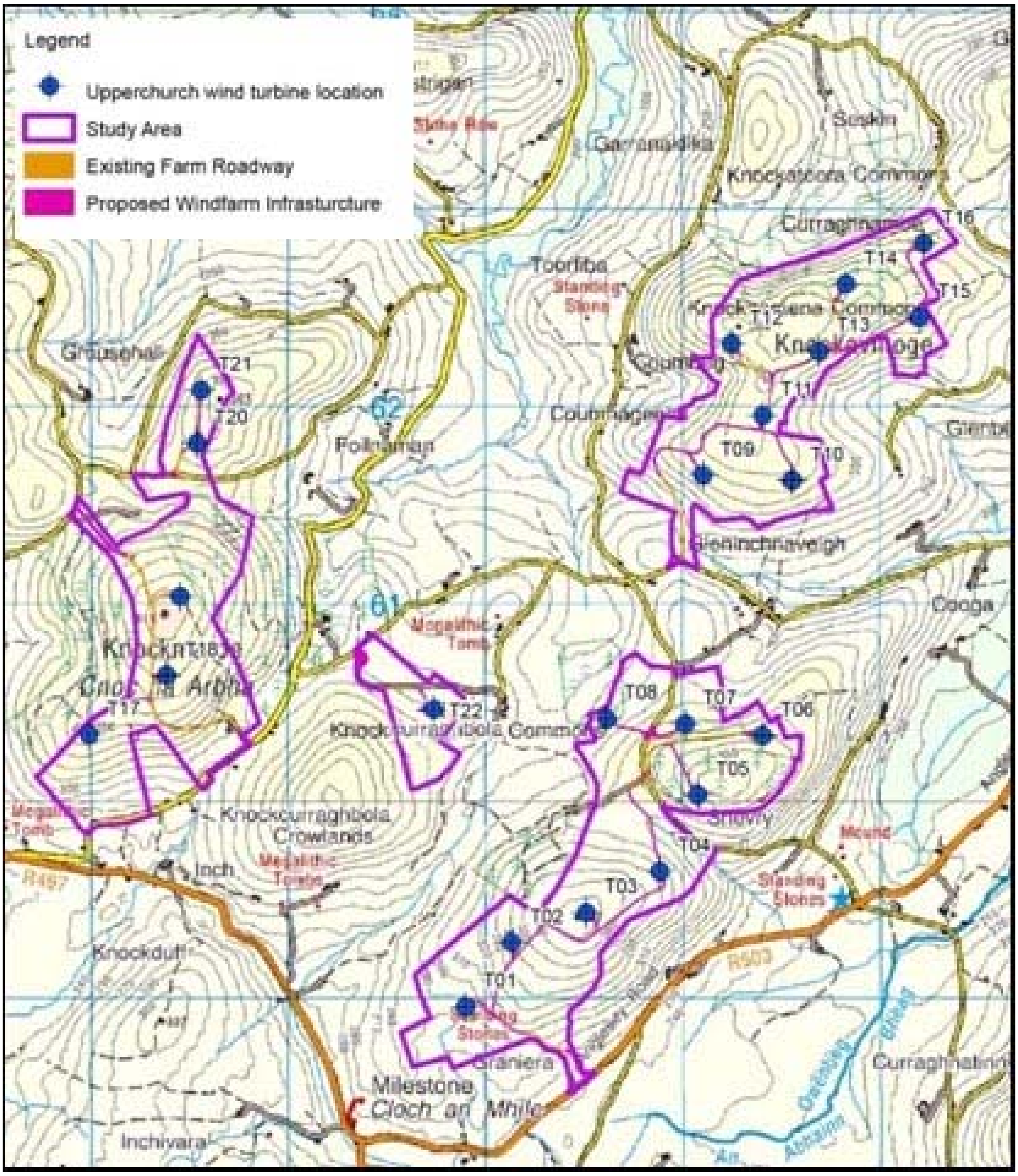
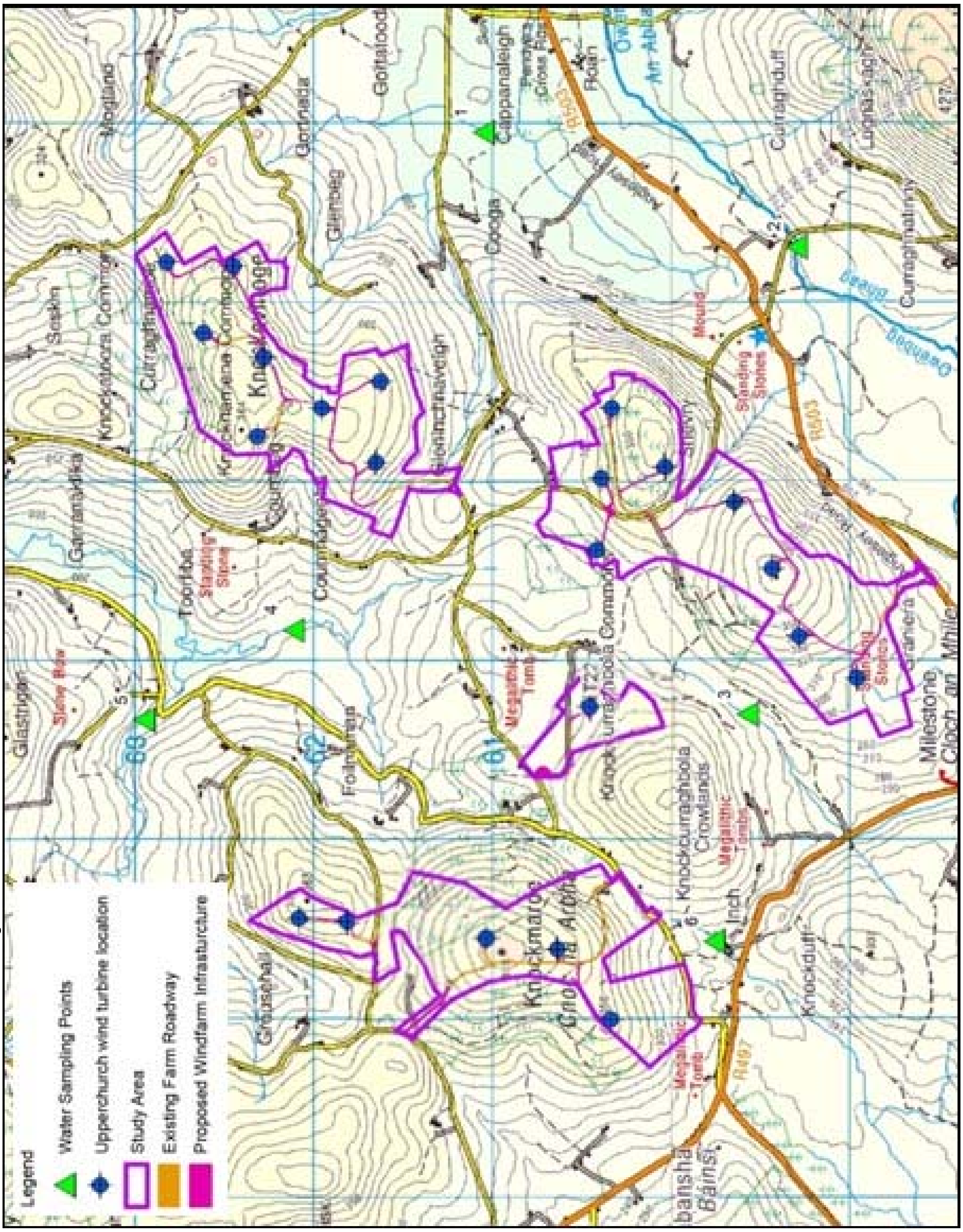


FIGURE 15 - 2: WATER QUALITY SAMPLING POINT LOCATION



Malachy Walsh and Partners
Consulting Engineers

FIGURE 15 - 3: GSI INTERIM VULNERABILITY CLASSIFICATION MAP

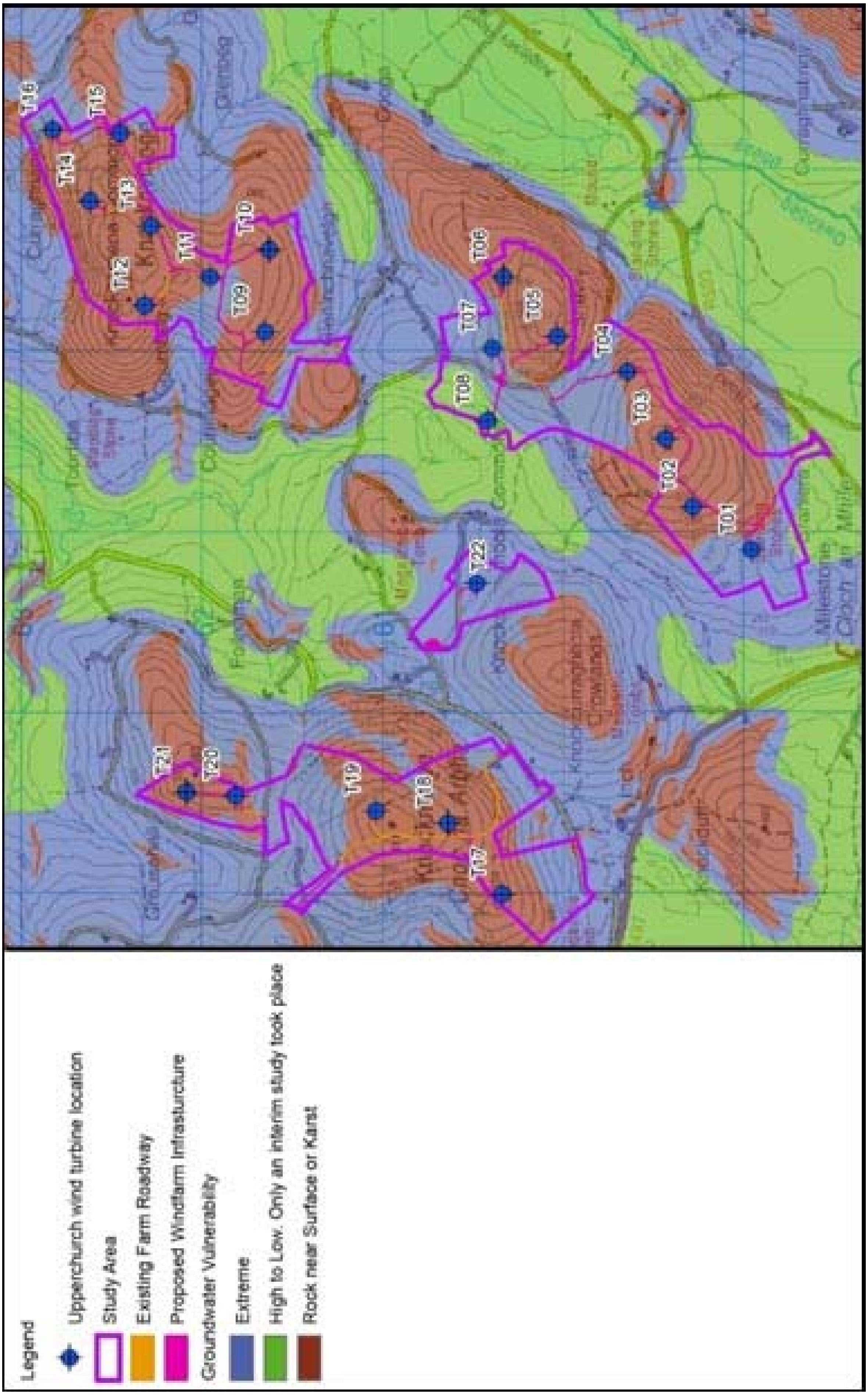


FIGURE 15 – 4 : PRELIMINARY FLOOD RISK ASSESSMENT MAP (2019/MAP/150/A)

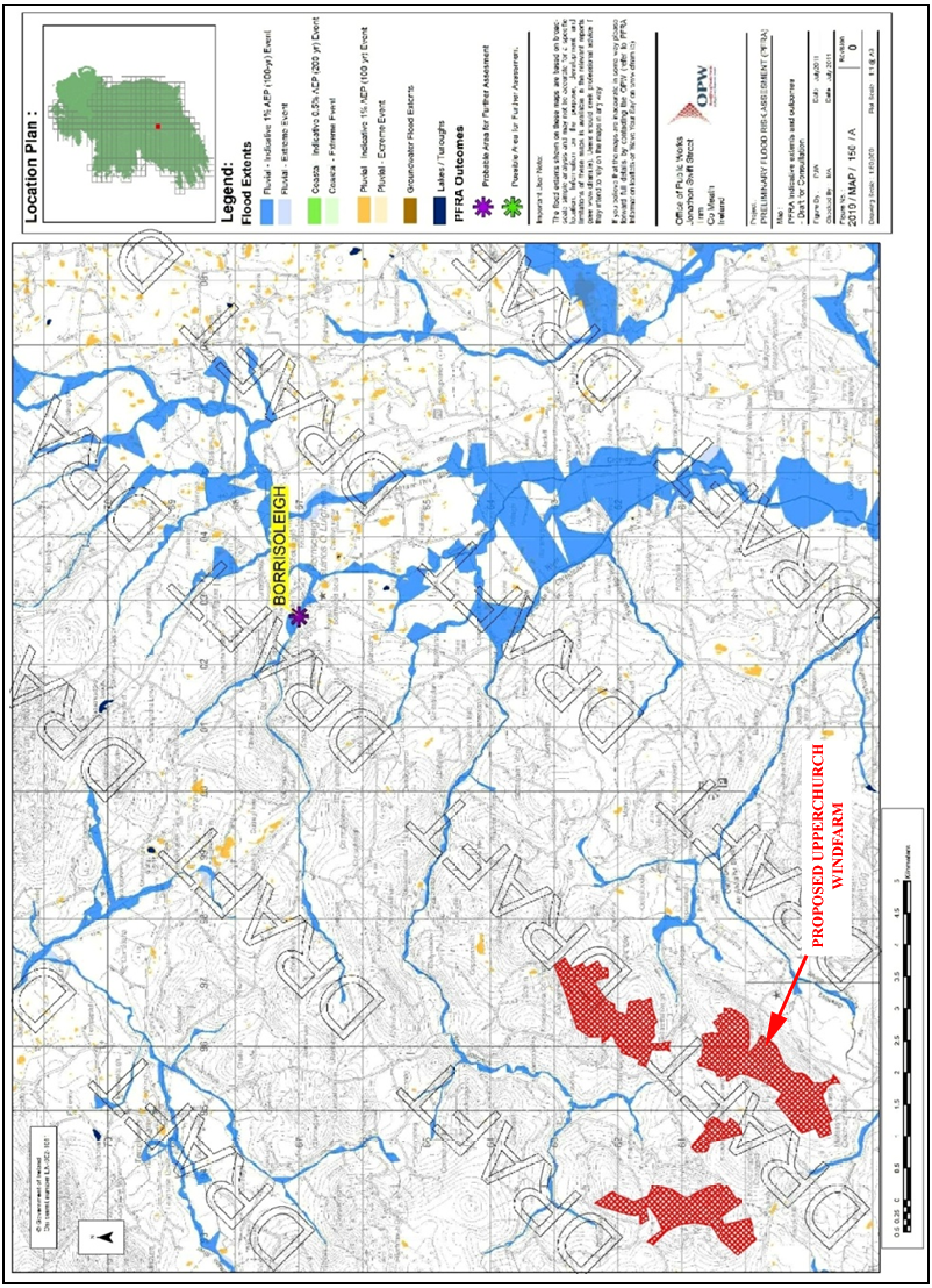


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FIGURE 15-5: TREE CLEAR FELLING AREAS

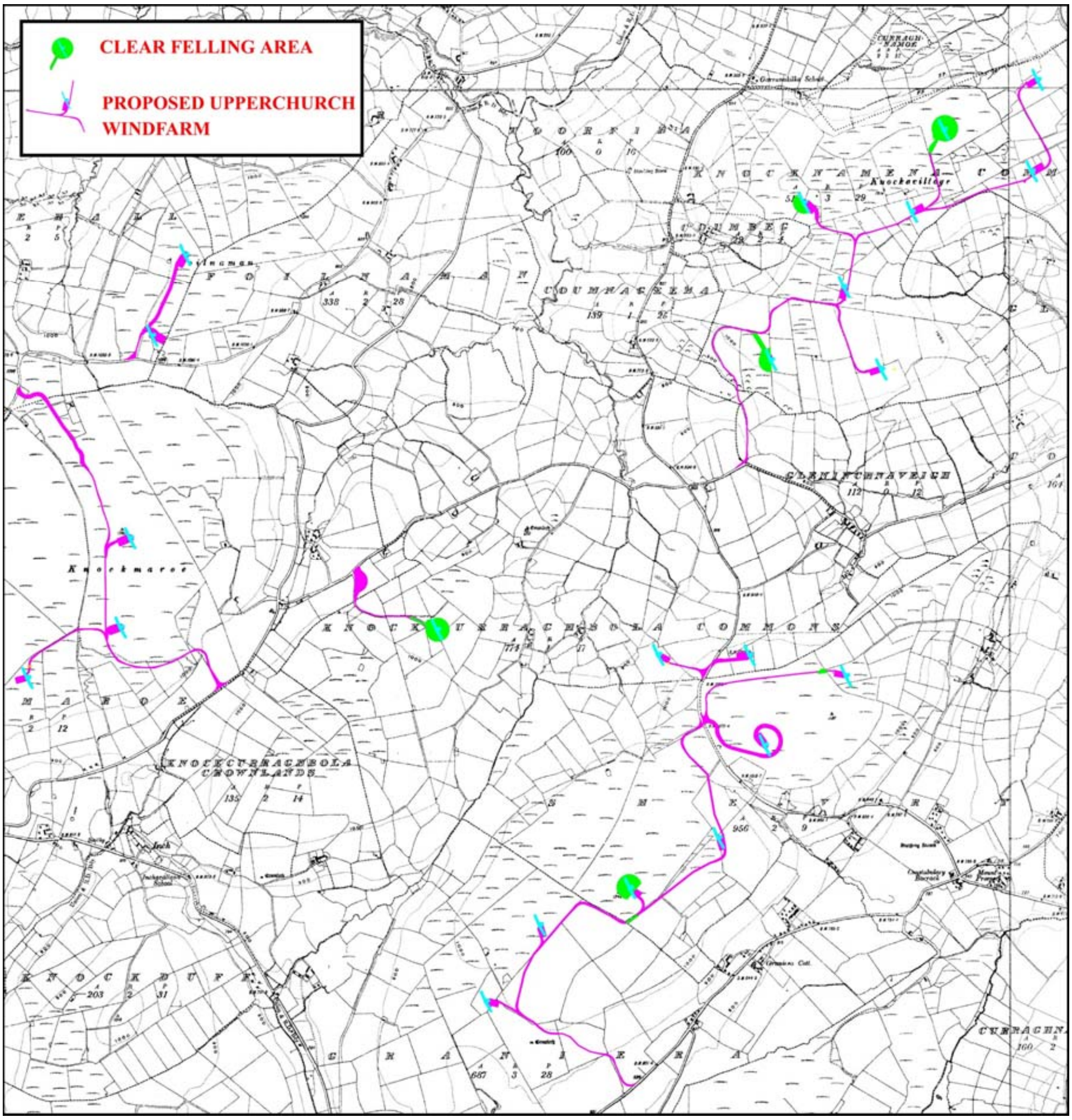
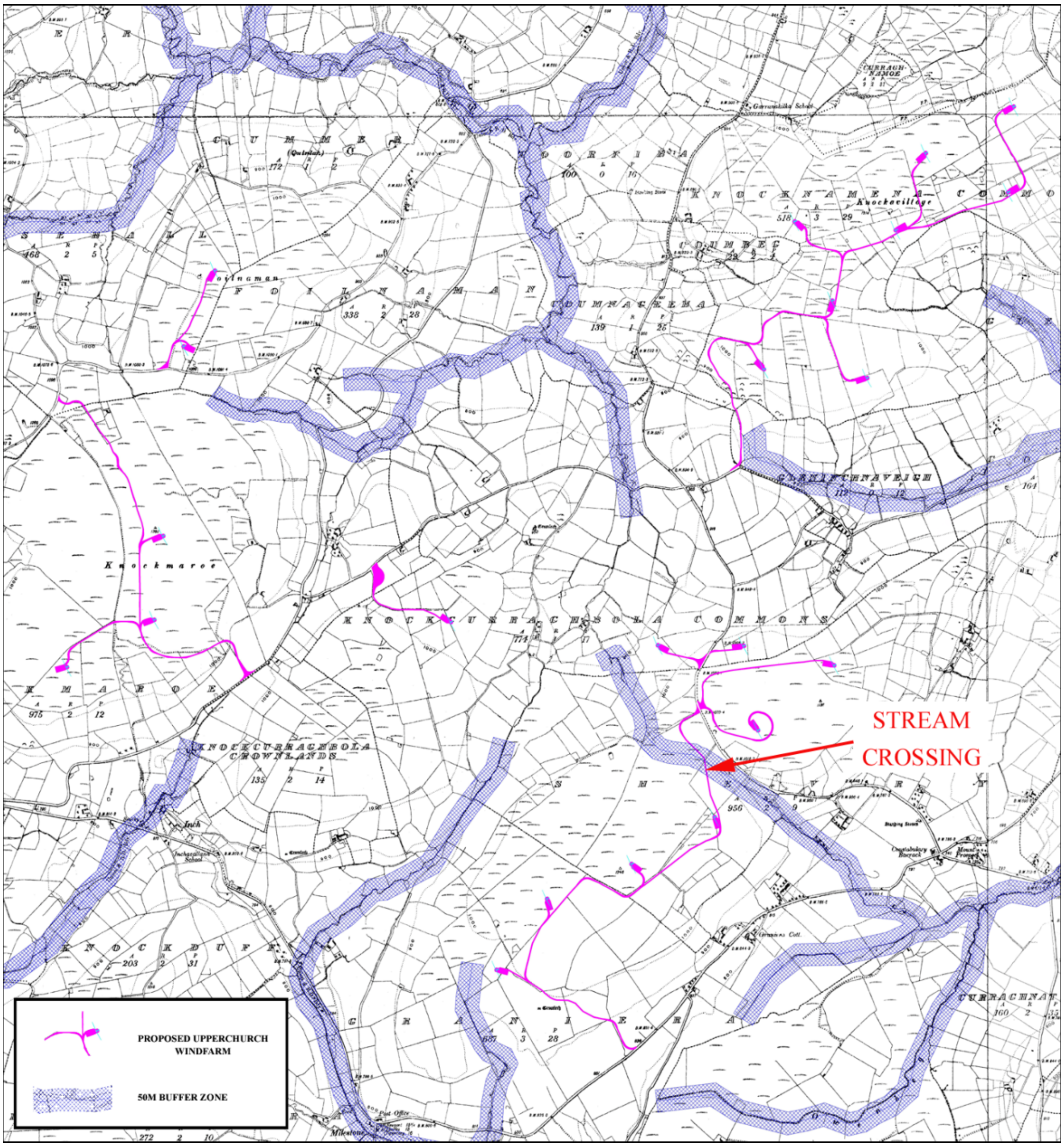


FIGURE 15-6: STREAM CROSSING AND 50M BUFFER ZONE



Upperchurch Windfarm Environmental Impact Statement

Malachy Walsh and Partners

Consulting Engineers

Cork | Tralee | Limerick | London

WINDFARM DEVELOPMENT

UPPERCHURCH, THURLES, COUNTY TIPPERARY

SEDIMENT AND EROSION CONTROL PLAN

ECOPOWER DEVELOPMENTS LIMITED

Project	Document	Revision	Prepared	Checked	Status	Date
14708	6002	B	Sean Doyle	Jack O'Leary	Final	24 September 2012

1 Introduction

Sediment such as peat, clay and silt can cause significant pollution during the construction phase of civil engineering projects due to erosion of exposed soil by surface water runoff. This plan has been prepared to control runoff and prevent erosion during the construction phase of the Upperchurch Wind Farm. The implementation of sediment and erosion control measures is essential in preventing sediment pollution. Erosion control is intended to prevent runoff flowing across exposed ground and becoming polluted with sediments while sediment control is designed to slow runoff (Murnane et al., 2006).

The sediment and erosion plan is compiled with regard to:

- Knowledge of the site's environmental conditions;
- Previous construction experience with wind farm developments in similar upland environments;
- Previous experience of environmental constraints and issues from construction in other wind farms in similar environmental conditions;
- Mitigation measures outlined in other EIS Chapters most notably **Chapter 9, Hydrology and Hydrogeology**; and
- A number of technical guidance and best management practice manuals.

The following site specific information was used to compile the sediment and erosion plan:

- High resolution aerial photography;
- OSi 10m Contour data;
- Wind farm infrastructure layout (turbines, sub-station, roads and ancillary development);
- Hydrology maps (watercourses and buffer zones);
- Soil and land use maps; and
- Modified Bilham Tables of rainfall intensity, duration and frequency.

2 Site description

The site is located within a series of small hills or drumlins to the west of Upperchurch village and 18 kilometres to the west of Thurles. The hills are at elevations of between 363mOD and 411mOD and the peaks are generally at heights of 100m above the intervening lower terrain.

The Slievefelim to Silvermines Mountains SPA lies to the west of the site. Most of the site is within the South Eastern River Basin District and drains to the Owenbeg, Turraheen and Clodiagh Rivers and ultimately to the River Suir. The remaining part of the site at the south western extremity is within the Shannon River Basin District and drains to the Aughvana River and ultimately to the Mulkear River.

The area is underlain by Silurian Metasediments and Volcanics with subsoils consisting of Devonian / Carboniferous sandstone and shale till. Some rock outcropping occurs, most notably at the northeast part of the site. The area originally had shallow peat land cover but most of it has been reclaimed by deep ploughing and converted to pasture. The remaining peat areas are used for commercial forestry.

Overall it is a landscape much altered by human activity.

3 Control of Sediment and Erosion

This plan has been designed to cause minimal disturbance to the current hydrological regime and minimise suspended sediment loading. Reduction of sediment loading is important as the site drains to a number of streams and rivers immediately to the north, east and south that ultimately drain to the River Suir and to the Mulkear River (a tributary of the River Shannon). Therefore, mitigation measures are required to protect against suspended solid loading of headwater drainage during the construction stage of the project.

The plan will be implemented early in the construction phase, prior to the main site clearance works and preferably during dry weather conditions to control increased runoff and associated suspended solids loads in discharging waters from the development areas. The plan can be implemented in phases as work progresses through the site. The events and locations with the highest potential for sediment runoff include:

- During and after heavy rainfall events or prolonged rainfall;
- Areas where construction activities (earthworks) are taking place;
- Steep slopes;
- Temporary stockpiles;
- Borrow pits;
- Areas of exposed ground;
- During bridge or drain works (e.g. during implementation of the drainage network) and
- Clear felling.

The proposed drainage layout and sediment control details are shown on the following figures which are at the end of this report:

- **FIGURE 15-I-1 to 15-I-4** – Proposed Drainage Layout;
- **FIGURE 15-I-5** – Internal Road Details;
- **FIGURE 15-I-6** – Site Drainage Details.

And are shown on the following drawings which accompany this Environmental Impact Statement:

- **Drawings 14708-5001 to 14708-5004** – Proposed Drainage Layout;
- **Drawing 14708-5005** – Internal Road Details;
- **Drawing 14708-5006** – Site Drainage Details.

It is proposed to combine sediment and erosion control measures to reduce the pollution runoff from the site during the construction phase of Upperchurch wind farm. It is important to reduce erosion of soil and peat where possible to prevent sediment suspension in runoff.

No work will take place within 50m buffer zones of watercourses except for clear span bridges or culverts and associated road construction. All construction method statements will be developed in consultation with Inland Fisheries Ireland – Shannon River Basin District and South Eastern River Basin District.

Generally, the footprint of the works area of a wind farm development represents only a small proportion of the overall catchment area intercepted by the site. Unless appropriate measures are put in place the works area can potentially contaminate all the runoff from the upstream catchment, creating an excessive volume of contaminated water which is then difficult to manage. The aim of this sediment and erosion plan is t**o intercept the clean water runoff from the upstream catchment and to isolate it from the contaminated water flowing from the works areas**. This minimises the volume of contaminated water that has to be cleaned before it is released to the downstream receiving waters.

3.1 PROTECTION OF CLEAN WATER FROM THE UPSTREAM CATCHMENT

A fundamental principle of the design of the sediment and erosion plan is that clean water flowing in the upstream catchment, including overland flow and flow in existing streams, is not contaminated by silt from the works area. Existing stream crossings, the works area will be piped. New drains will be constructed to collect overland flow that is intercepted by the works areas or by new access roads. These will be constructed on the uphill side of the works and piped to the downhill side, bypassing the works areas, thereby preventing contamination with construction related runoff water. However, this will cause the normally dispersed flow to be concentrated at specific discharge points downstream of the works. In order to disperse the flow each clean water drain will be terminated in a discharge channel running parallel to the ground contours that will function as a weir to disperse the flow over a wider area of vegetation. This will prevent erosion of the ground surface and will attenuate the flow rate to the downstream receiving waters. The resultant diversion of clean water runoff will ensure that the sediment and erosion control measures will only need to deal with construction related runoff.

3.2 TREATMENT OF WATER FROM THE WORKS AREAS

Runoff from the works areas will be isolated from the clean catchment runoff by means of a series of open drains that will be constructed on the down-hill side of the works. These drains will be directed to settlement ponds that will be constructed throughout the site, downhill from the works areas. The ponds have been designed to a modular size to cater for a single turbine hard standing area or a 1,000m^2 area of internal access road. Each drain will incorporate a series of check dams that will attenuate the flow and provide storage for the increased runoff from exceptional rainfall events. Where larger areas of runoff have to be catered for at a single discharge point the size of the settlement lagoon will be increased pro rata. At locations where fine silt particles, less than 20 microns in size, are present in the runoff, larger settlement ponds will be required. Proprietary clarifiers may be used as an alternative, with the addition of flocculants where necessary.

Excavation of drains will cause an initial drawdown of the water table in the immediate vicinity at locations where it is above the drain invert. The clay layers will have low permeability and the underlying till will have moderate permeability. Some seepage can occur from these layers but, based on site investigation information, is expected to be minimal. The volume and rate of flow from this source are unlikely to be significant or to exceed the capacity of the settlement ponds which are designed for extreme storm events.

Dewatering of turbine base excavations can result in significant flow rates to the drainage and settlement system if high capacity pumps are used. In order to avoid the need for pumping it is proposed to provide drainage channels from the excavations so as to prevent a build up of water. Where this is not feasible, dewatering should only be carried out at a flow rate that is within the capacity of the sediment ponds

The design of the settlement ponds in outlined below.

3.3 SETTLEMENT PONDS

Drains carrying construction site runoff will be diverted into settlement ponds that reduce flow velocities, allowing silt to settle and reducing the sediment loading. Settlement ponds have been designed as a three-stage tiered system and this has been proven to work effectively on wind farm construction sites. The three-stage system also facilitates effective cleaning with minimal contamination of water exiting the pond. The settlement ponds have been designed with regard to the following:

- Size of construction area and associated runoff flow rate (clean water from the surrounding catchment will be diverted away from construction area);
- Modified Bilham Tables for rainfall intensity and duration;
- Expected sedimentation rates; and
- Character of the impermeable areas (runoff coefficients).

Settlement ponds will require inspection and cleaning when necessary. This will be carried out under low or zero flow conditions so as not to contaminate the clean effluent from the pond. The water level would first be lowered to a minimum level by pumping without disturbing the settled sediment. The sediment would then be removed by mechanical excavator and disposed of in areas designated for deposition of spoil. Ponds will also require perimeter fencing and signage to ensure that there are no health and safety risks.

Contaminated runoff can be generated on the site access roads, construction compounds, sub-station sites and turbine hard standing areas and is mainly due to excavation for the infrastructure or movement of delivery vehicles and on-site traffic. A modular approach has been adopted for the design of the settlement ponds which have been sized to cater for a catchment area of 1,000m^2 works area. This is equivalent to a road length of 200m or the area of a typical turbine hard standing.

Generally, high intensity rainfall events have a short duration and lower intensity rainfall events tend to have a longer duration. The Bilham Table for statistical rainfall events demonstrates that exceedance probability decreases as intensity or duration increases. The runoff control measures for the wind farm site have been designed in the context of storm events of varying duration and intensity. The settlement ponds have been designed to cater for a maximum continuous flow rate associated with a medium-intensity rainfall event.

Higher intensity runoff will be attenuated by the open drain collection system which provides temporary storage and limits the rate at which it enters the settlement ponds. This is achieved by the use of check dams within the open drains as described elsewhere in this document. Longer duration storms of 24 hours or more generally have very low intensity and are not critical in terms of the runoff rates that they generate. Since the design is for the construction phase only, no additional allowance has been made for possible increase in rainfall intensity due to climate change in the future.

3.3.1 Design flow rate

The modular settlement ponds are designed to operate effectively for the runoff rate associated with a continuous high rainfall event of 20mm/hour. This is equivalent to a 60 minute duration storm event with a 5-year return period (M5-60) or a 25 minute duration storm event with a 1-year return (M1-25).

The design runoff rate is calculated using the formula:

$Q = c\,i\,A$

where c is the runoff coefficient

i is the rainfall intensity in m/sec and

A is the catchment surface area in m^2

A runoff coefficient of 0.70 is assumed for the hardcore surface. For a rainfall intensity of 20mm/hour and an area of 1,000m^2 the runoff rate is:

$Q = 0.70 \text{ x } (0.02/3600) \text{ x } 1{,}000 \text{ m}^3\text{/sec}$

$= 0.0039 \text{ m}^3\text{/sec}$ (3.90 litres/sec)

3.3.2 Pond surface area

The main design parameter for the settlement pond is the water surface area. The required surface area is the design flow rate in m^3/sec divided by the particle settlement velocity (V_s) in m/sec (Area = Q/V_s m^2). The particle settlement velocity is determined using the formula derived by Stokes in 1851 as follows:

$V_s = 2 r^2 (D_p – D_f) / (9 n)$

where V_s is the particle settling velocity (m/sec)

r is the radius of the particle (metres),

D_p is the density of the particles (kg/m^3);

D_f is the density of the fluid (kg/m^3),

n is the viscosity of the fluid (0.000133 kg sec/m^2 @ 10°C).

For a particle density of 2,700kg/m^3 and diameter of 20 microns the settlement velocity V_s is 0.000284m/sec.

The required settlement pond surface area is

$A = Q/V_s$

= 0.0039/0.000284

= $13.70m^2$

Theoretically the pond depth is not relevant but in practice a minimum depth is required to ensure laminar flow and to allow temporary storage of settled silt. The modular settlement pond has been designed conservatively with a surface area of $24m^2$ (12m x 2m) and a depth of 1m. This is divided into three chambers of equal length and in practice it has been found that most of the settlement occurs in the first chamber with very low turbidity levels being achieved in the final effluent. The design is conservative and therefore has sufficient redundancy to cater for occasional higher runoff rates or sediment loads.

For practical reasons it may be necessary to increase the area directed to a settlement pond in which case the pond surface area will be increased pro rata.

3.3.3 Extreme flow rates

For rainfall intensities above the design value of 20mm/hour the excess runoff needs to be temporarily stored. The storage can be provided in the drainage channels by installing check dams at intervals along the channel as described below.

The storage volumes required for 10-year storm events of various durations are shown in the Table 1 below. The volumes are based on a catchment area of $1,000m^2$ and a runoff coefficient of 0.70. The maximum storage volume required is $6.98m^3$ for 20 minutes storm duration. This is equivalent to 30 minutes of flow through the settlement pond at the design through flow rate of 3.90 litres/second. The stored water will drain off gradually as runoff from the works area subsides. The storage volume represents an average depth of 0.06m in a 200m long, 0.60m wide open drain and can therefore be easily accommodated in the drainage system.

Storm Event	Duration (minutes)	Rainfall rate (mm/hour)	Excess (mm/hour)	Runoff Coefficient	Storage Volume (m^3)
M10-60min	60	24.50	4.50	0.70	3.15
M10-40min	40	32.40	12.40	0.70	5.79
M10-30min	30	39.10	19.10	0.70	6.69
M10-20min	20	49.90	29.90	0.70	**6.98**
M10-10min	10	71.40	51.40	0.70	6.00
M10-5min	5	94.90	74.90	0.70	4.37

TABLE 1 - CALCULATED STORAGE VOLUMES

The ability to limit flow rates is fundamental to the control of sediment during extreme storm events. It is not proposed to use any proprietary mechanical devices for this purpose but instead to rely on the check dams to effectively limit flow rates to the required levels. The check dams are constructed with gravel or other suitable material and will be of sufficient length and height to provide the required attenuation rates. This will vary depending on the gradient of the drainage channel with higher gradients requiring a greater number of dams with larger dimensions. Their ability to retain water and release it slowly can be confirmed visually.

3.3.4 Outflow Weirs

The effluent from each settlement pond will discharge to an open channel, 8 to 10 metres in length, running parallel to the ground contours. This will form a weir that will overflow on its downhill side and disperse the flow across the existing vegetation. A minimum buffer width of 20m is specified between the overflow weir and downstream watercourses. Buffer widths are designed in line with Scottish Forestry Commission Guidelines (2004) on protection of water courses during forestry operations and management. This method buffers the larger volumes of run-off discharging from the drainage system during periods of high precipitation, reducing the hydraulic loading and further reducing suspended sediment load to surface watercourses. In general, the outflow weirs should not be located on slopes steeper than 3:1 or in areas of high peat stability risk. However, since there are no areas of deep peat in the Upperchurch site, peat stability is not a particular risk in this case.

3.3.5 Check dams

Check dams will be placed at regular intervals based on bed gradient along all drains to slow down runoff, facilitate settlement and reduce scour and ditch erosion. Check dams are relatively small and composed of gravels or other suitable material. Depending on the longitudinal gradient they will be placed at distances and heights that allow small pools to develop behind them. This is required in order to attenuate flow to the settlement ponds during storm events where the runoff rate would otherwise exceed the settlement pond capacity.

FIGURE 1 EXAMPLES OF CHECK DAMS AND EXAMPLE OF SILT FENCE USED IN CONJUNCTION WITH CHECK DAMS ALONG ROADSIDE DRAINAGE CHANNELS

3.4 SEDIMENT CONTROL MANAGEMENT

The settlement ponds and check dams described in the previous section provide the essential mechanism for the removal of silt from construction related runoff and the controlled return of the treated runoff to the downstream watercourses. Additional infrastructure and control methodologies are also required in order to minimise the sediment load from the runoff and to prevent contamination by other potential pollutants.

3.4.1 Working near watercourses

No work will take place within 50m buffer zones of watercourses except for clear span bridges or culverts and associated road construction. Working near watercourses during or after intense or prolonged rainfall events will be avoided and work will cease entirely near watercourses when it is evident that there is a risk that pollution could occur. All construction method statements will be developed in consultation with Inland Fisheries Ireland – Shannon and South Western River Basin Districts.

3.4.2 Minimise exposed area

The area of exposed ground will be kept to a minimum by maintaining where possible existing vegetation that would otherwise be subject to erosion in the vicinity of the wind farm infrastructure and keeping excavated areas to a minimum. The clearing of peat, where it occurs, will be delayed until before construction begins rather than stripping the entire site months in advance particularly during road construction.

3.4.3 Silt fences

Silt fences or other appropriate silt retention measures will be installed where there is a risk of erosion runoff to watercourses from construction related activity particularly if working during prolonged wet weather periods or if working during intense rainfall events. Silt fences can be used in conjunction with check dams in drains. Preliminary site works, and particularly the construction of the drainage system, will require the use of silt fences to prevent siltation due to ground disturbance caused by excavation works.

3.4.4 Engineered deposition areas

Temporary engineered deposition areas will be designated and designed to hold temporary stockpiles and located away from drains and watercourses. Stockpiles that are at risk of erosion will be protected by silt trapping apparatus such as a geo-textile silt fences to prevent contamination of runoff.

3.4.5 Felling

Permanent tree felling will take place to facilitate access to the wind farm infrastructure. All associated tree felling will be undertaken using good working practices as outlined in *Forestry Harvesting and the Environment Guidelines* and *Forestry and Water Quality Guidelines*, both published by the Forest Service, Department of Marine and Natural Resources, July 2000. The latter guidelines deal with sensitive areas, erosion, buffer zone guidelines for aquatic zones, ground preparation and drainage, chemicals, fuel and machine oils.

3.4.6 Establish vegetation

As part of the works, some areas of organic soil and peat will be permanently removed. These areas include the locations of new roads, turbine bases, hard standings and electrical sub-station compound. The soil can be re-used to remediate exposed areas and prevent erosion in the future when the civil works have been completed.

In addition, some exposed areas of the site that are slow to re-vegetate may need to be replanted with suitable vegetation. This can be by natural regeneration or by reseeding. Natural regeneration relies on colonisation of bare ground by native species from adjacent habitats. A roughened surface will be provided, which can trap seeds and soil to provide initial regeneration areas. The need for replanting or reseeding will be decided by the developer in consultation with the project ecologist near the end of the construction phase.

3.4.7 Road runoff

All access roads are to be stabilised and maintained after grading followed by a final capping with crushed limestone or similar quality stone. Limestone or similar quality stone can significantly reduce road related runoff resulting from construction traffic and the road stone. The road surface can become contaminated with clay or other silty material during construction. Road cleaning will, therefore, need to be undertaken regularly during wet weather to reduce the risk of sediment runoff to watercourses. This is normally achieved by scraping the road surface with the front bucket of an excavator and disposing of the material at designated locations within the site.

3.4.8 Wheel washes

Wheel washes will be provided for exiting heavy vehicles to ensure roads outside of the site boundary are clean. It is recommended that a designated bunded and impermeable wheel wash area is provided and resultant waste water is diverted to a settlement pond for settling out of solids. If a pumped dewatering system is required it will be well planned and pumped water will be adequately treated in the settlement pond.

3.5 OPERATIONAL PHASE

The measures for control of runoff and sediment relate to the construction phase of the project when there is continuous movement of site vehicles and delivery vehicles. Following construction the amount of on-site traffic will be negligible and there will be no particular risk of sediment runoff. It is therefore proposed to partly fill the sediment ponds with stone so that they will not present a long-term safety risk. Runoff from the roads, hard-standings, and other works areas will continue to be directed to these ponds and from there to the outfall weirs. Check dams within the drainage channels will also remain in place. The retention of this drainage infrastructure will ensure that runoff continues to be attenuated and dispersed across existing vegetation before reaching the downstream receiving waters.

3.6 FLOOD ATTENUATION

The creation of impermeable areas within a development site has the effect of increasing rates of runoff into the downstream drainage system and this may increase flood risk and flood severity downstream. This applies particularly to urban areas that drain to closed pipe systems which do not have the capacity to cater for increased hydraulic loads. The Upperchurch wind farm development is located within a large rural catchment with an open drainage system. The footprint of the impermeable areas and the associated increase in runoff rate is very small in the context of the catchment size and therefore presents a negligible increase in downstream flood risk. Notwithstanding the low increase in flood risk due to the development, the drainage system has been designed to prevent any increase in discharge rates above that which already exist in the undeveloped site.

The following flood attenuation measures have been incorporated into the design:

- Existing drains will bypass the works and no additional runoff will be routed directly into them;
- Overland flow of clean water that is intercepted by the works will be collected in open drains, piped to the downhill side of the works, and dispersed over existing vegetation by means of overflow weirs as described elsewhere in this document. These will be provided at intervals of approximately 200m, the exact locations being determined on site at construction stage.
- Runoff from roads, hard-standings and other new surfaces will be also be dispersed across existing vegetation downstream of the works following removal of sediment in the settlement ponds. This flow regime will remain in place permanently after completion of the works.
- Some attenuation will be provided by the use of a series of gravel dams placed at intervals within the open drains carrying silt contaminated runoff. These are intended to limit the flow rate to the settlement ponds during construction but they will also provide attenuation of flow to the downstream receiving waters in the longer term during the operational phase of the wind farm. The overflow weirs downstream of the

settlement ponds will remain in place permanently so that the flow continues to be dispersed across existing vegetation and not directly to open drains or streams.

3.7 INSPECTION AND MAINTENANCE

Controls need to be regularly inspected and maintained to ensure that any failures, such as a build up of silt or a tear in a silt fence, are quickly identified and repaired so as to prevent to water pollution. Inspection and maintenance is critical after prolonged or intense rainfall while maintenance will ensure continued effectiveness of the sediment and erosion plan. A programme of inspection and maintenance will be designed and dedicated construction personnel assigned to manage this programme. A checklist of the inspection and maintenance control measures will be developed and records kept of inspections and maintenance works. Controls must work well during the operational phase of the wind farm until the vegetation has re-established.

3.8 WATER QUALITY MONITORING

Baseline water quality of all of the streams leaving the development site will be undertaken prior to construction. This baseline data will include the main components of a full hydrograph for the streams including both high spate flow and base flow where possible.

A weir or flume water level auto-logger and infra-red suspended solids sonde will be installed at select locations. This equipment will allow for continuous monitoring of water flow and associated suspended solids load during storm events. This equipment will be installed in time to monitor baseline conditions for at least 6 months prior to construction, and will be maintained during construction and post construction for at least 12 months.

During the construction phase of the project, water quality in the streams and outflow from the drainage and attenuation system will be monitored, field-tested and laboratory tested on a regular basis during different weather conditions. This monitoring along with the visual monitoring will help to ensure that the mitigation measures that are in place to protect water quality are working.

During the construction phase of the project, the development areas will be monitored regularly for evidence of groundwater seepage, water ponding and wetting of previously dry spots, and visual monitoring of the effectiveness of the constructed drainage and attenuation system to ensure it does not become blocked, eroded or damaged during the construction process.

3.9 CONCLUSION

Construction practices impact on the natural drainage patterns in a landscape. The intent is to keep clean water clean and to manage construction related runoff through a designed, managed and maintained sediment and erosion plan. Attenuation measures are incorporated into the design of the drainage and sediment control system.

The measures outlined above, in conjunction with the site drainage layout and details, will prevent sediment and erosion problems and will ensure that the development of the

Upperchurch wind farm will not have a significant impact on the River Suir and River Shannon or their tributaries.

3.10 REFERENCES

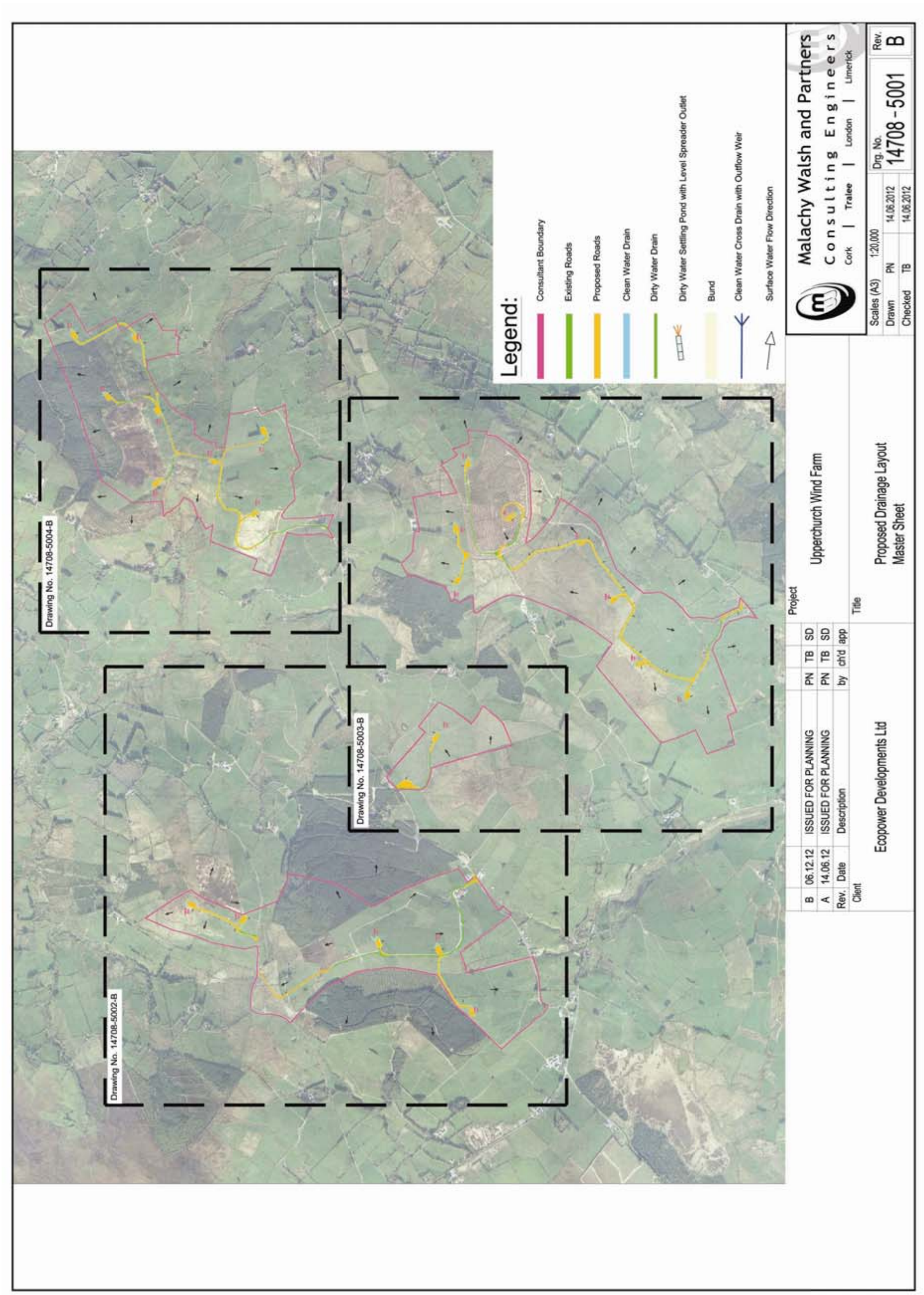
Forestry Commission (2004). "*Forests and Water Guidelines*". 4th Edition. Forestry Commission, Edinburgh, Scotland.

Forest Service, Department of Marine and Natural Resources, July 2000. Forest Harvesting and the Environment Guidelines.

Forest Service, Department of Marine and Natural Resources, July 2000. Forestry and Water Quality Guidelines.

Murnane, E., Heap, A. and A. Swain, 2006. Control of water pollution from linear construction projects. A Technical Guidance. A CIRIA publication, UK.

FIGURE 15-I-1: PROPOSED DRAINAGE LAYOUT MASTER SHEET



Upperchurch Windfarm Environmental Impact Statement

FIGURE 15-I-2: PROPOSED DRAINAGE LAYOUT SHEET 1 OF 3

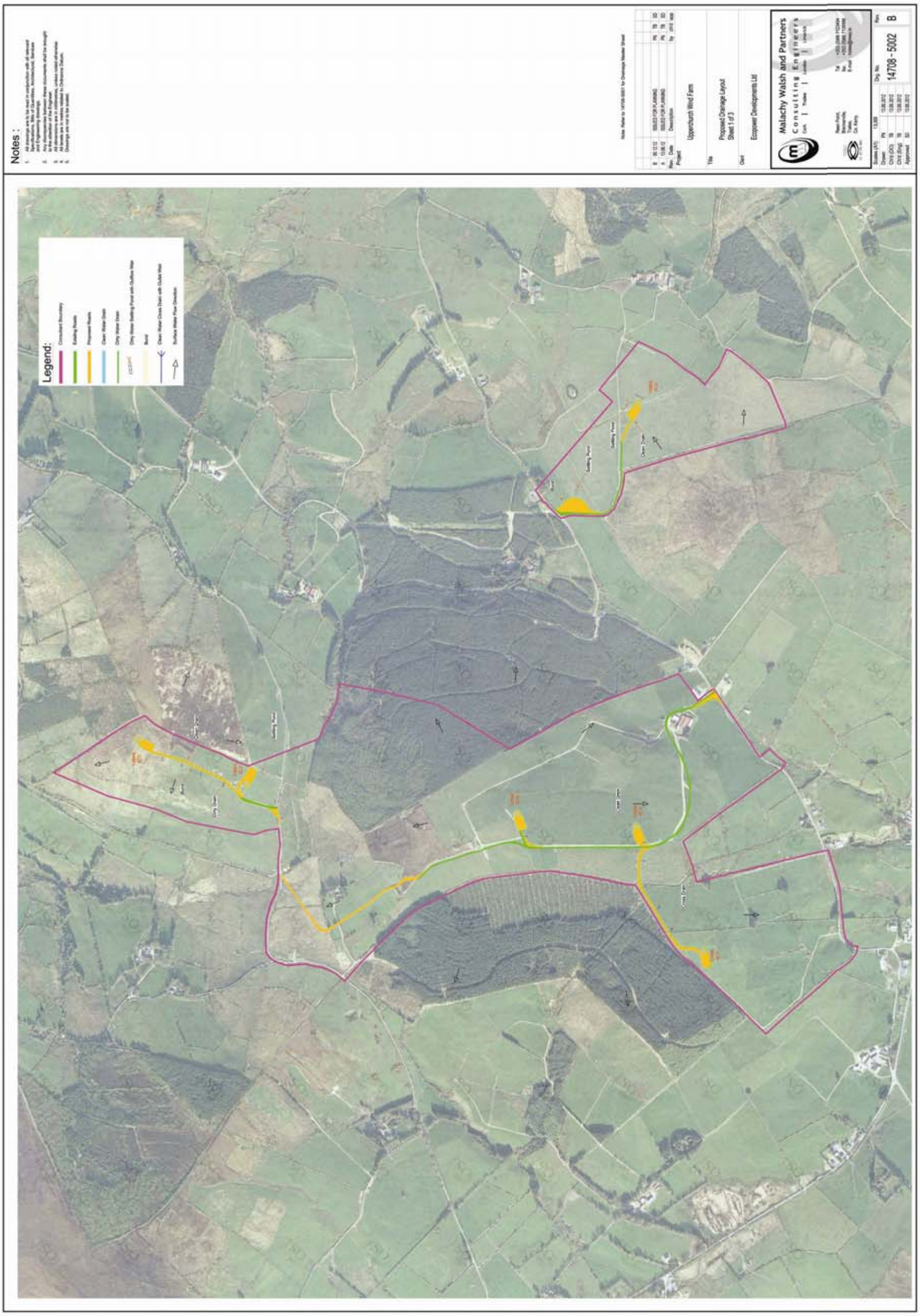


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FIGURE 15-I-3: PROPOSED DRAINAGE LAYOUT SHEET 2 OF 3

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FIGURE 15-I-4: PROPOSED DRAINAGE LAYOUT SHEET 3 OF 3

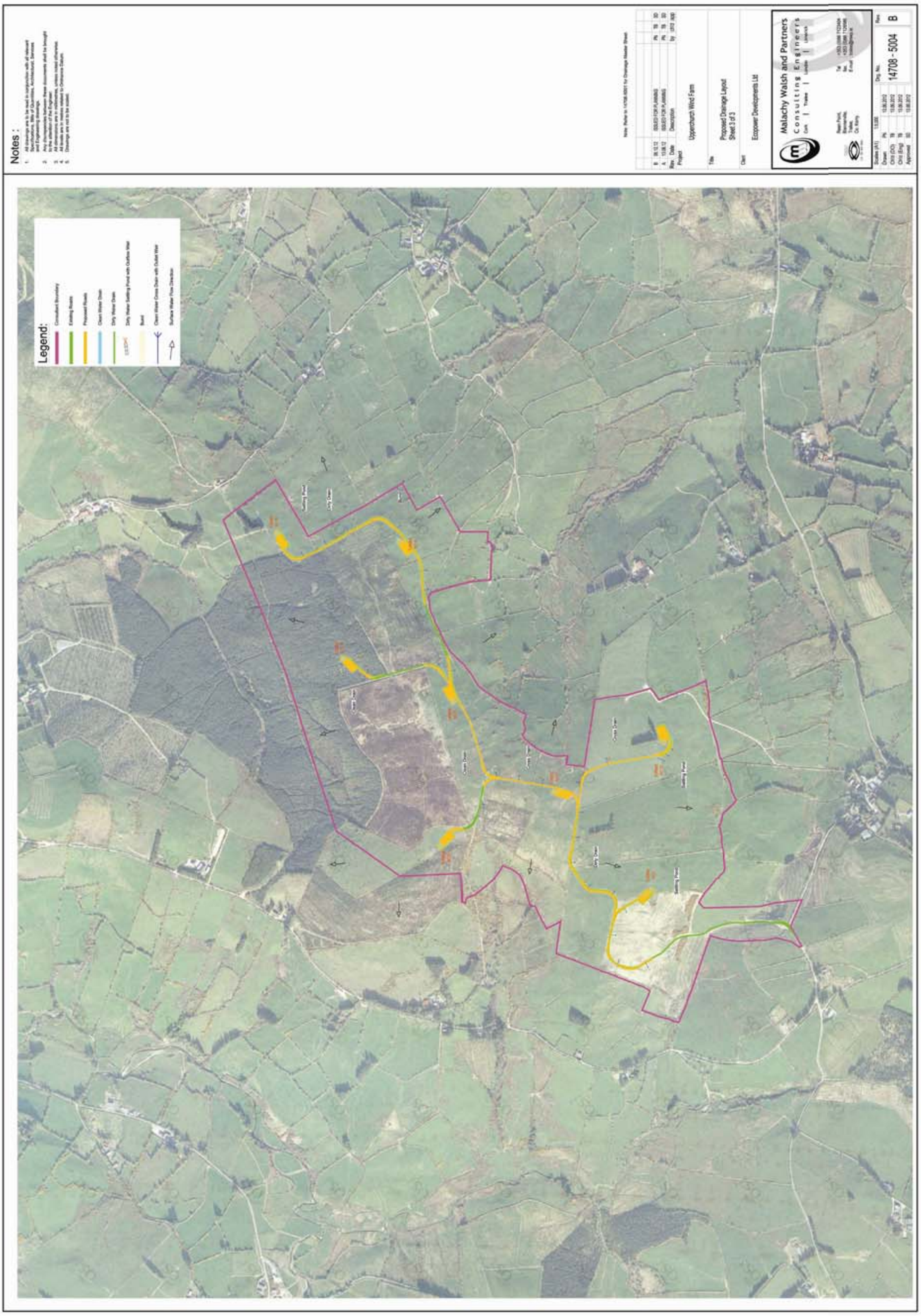

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FIGURE 15-I-5: PROPOSED INTERNAL ROAD DETAILS

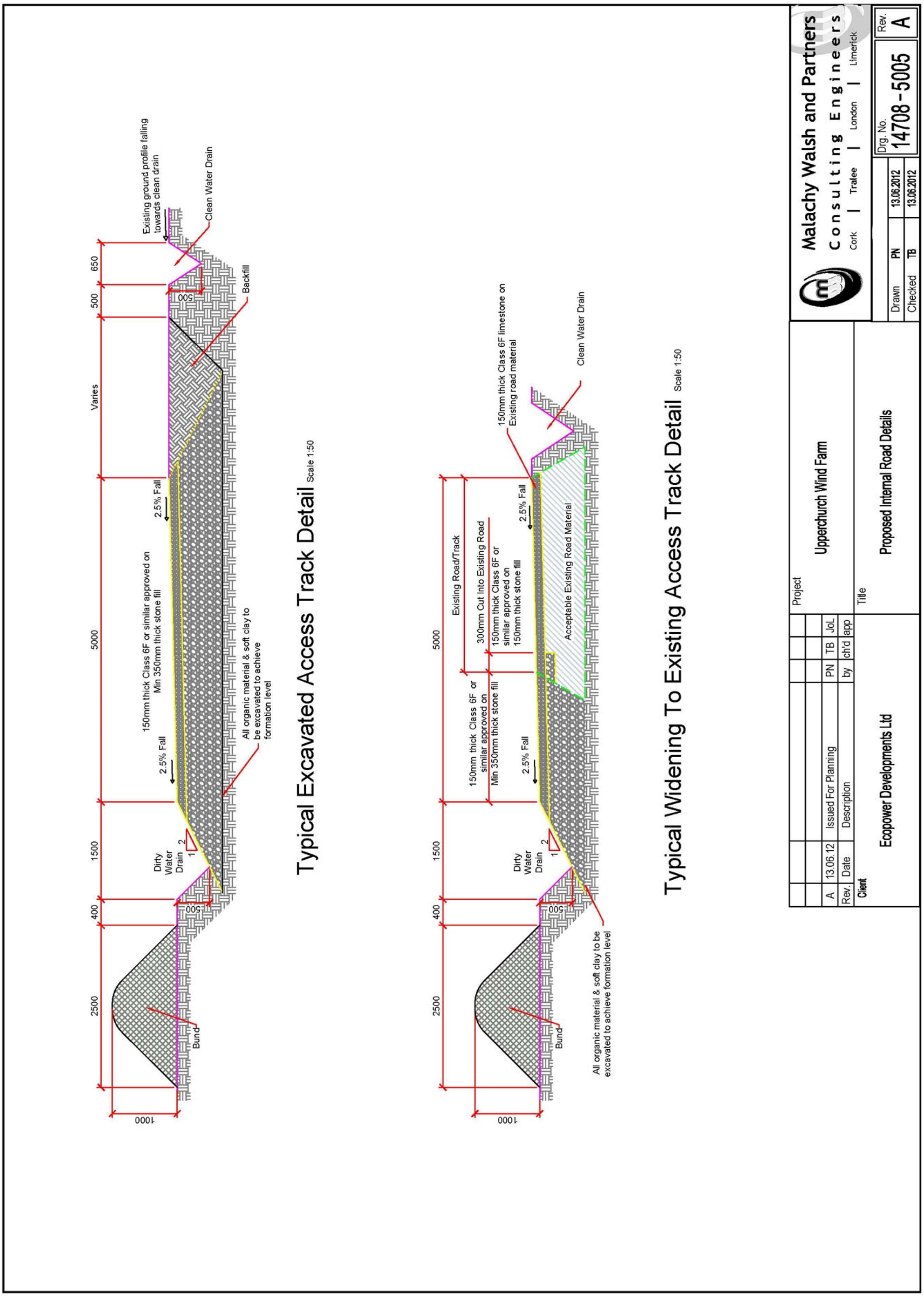
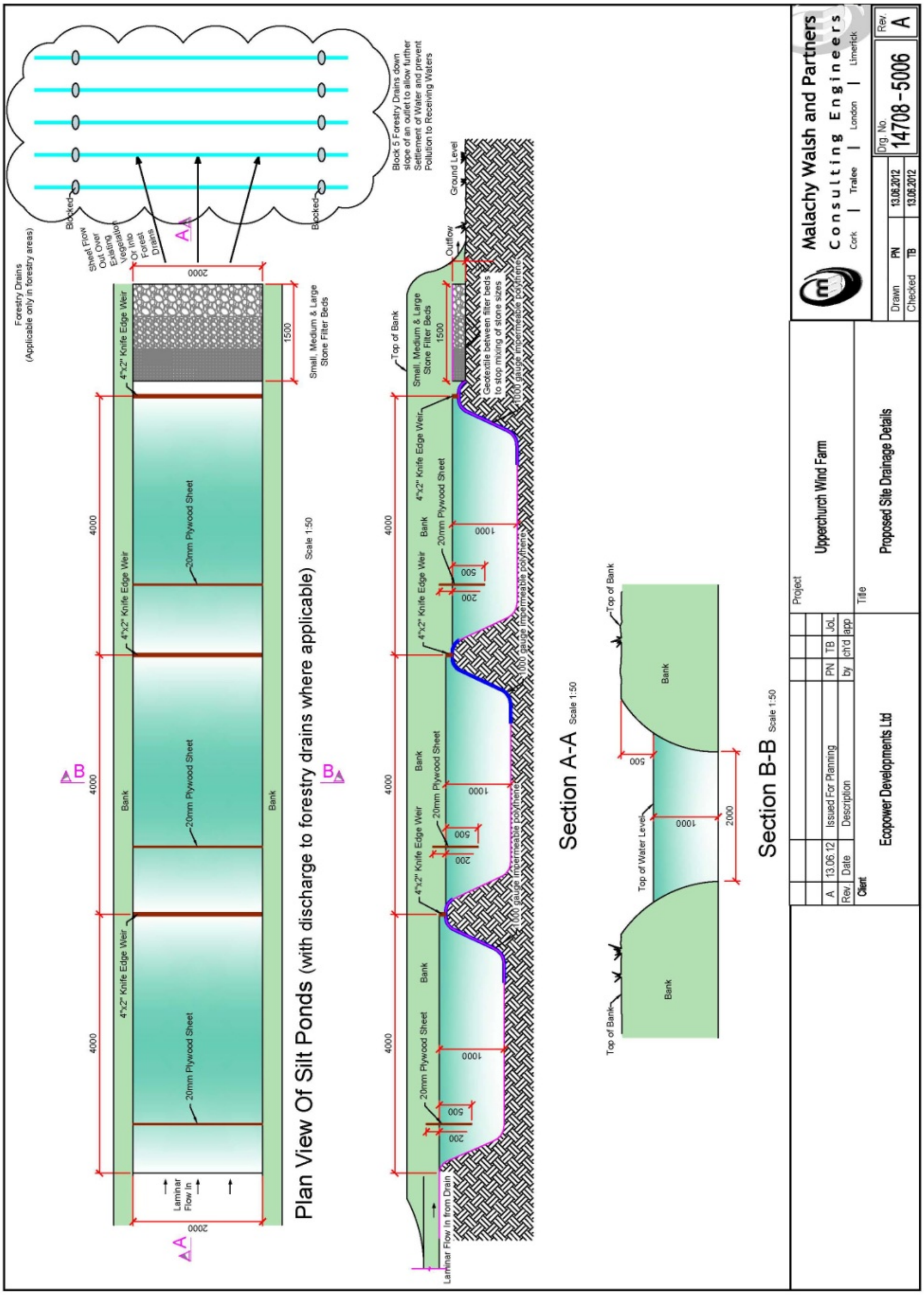


FIGURE 15-I-6: PROPOSED SITE DRAINAGE DETAILS



16. Conclusion

Wind energy is a clean, renewable and sustainable means of electricity generation. It can make a substantial contribution to reducing global environmental damage associated with the energy demands of modern lifestyles and development. Wind power is an indigenous source of fuel, which is everlasting and which Ireland has in abundance. If this resource is properly developed it will provide a significant amount of our energy requirement in the coming years,

The Environmental Impact Assessment on the proposal was carried out by;

- Ecopower Developments Ltd, Wind Energy Developer
- Malachy Walsh & Partners, Consulting Engineers
- Mozart, Landscape Architects
- Ai Bridges Ltd, communications solutions engineers
- Kilkenny Archaeology, chartered archaeologists

There is a clear environmental imperative and an increasing economic and security of supply imperative, to the development of renewable energy sources. Over one-fifth of new electricity generation capacity installed in Europe in 2011 was wind energy electricity generation. A binding target of 20% of all energy coming from renewable sources has been set for the EU to achieve by 2020, which would mean approximately 35% of electricity coming from renewables by then. Ireland is committed to this target in the Energy White Paper 2007.

The proposal is to construct 22 turbines in the townlands of Graniera, Shevry, Knockcurraghbola Commons, Gleninchnaveigh, Coumnageeha, Knocknamena Commons, Knockmaroe and Grousehall west of Upperchurch village, Co. Tipperary. For clarity of nomenclature this proposal is described throughout as the Upperchurch Windfarm. The Upperchurch windfarm is proposed for an area within a series of small hills 2km west of Upperchurch village and 18km to the west of Thurles, County Tipperary. It lies just north of the main road between Limerick and Thurles, which dissects the mountains from west to east and almost borders Milestone on its south-western extent.

The site is in an area zoned for wind farm development in the Wind Capacity Strategy which was adopted by the Council in 2009. The wind farm is proposed for the area Upperchurch – Kilcommon Hills as detailed in the Strategy. The Strategy states that this area has extensive capacity to absorb wind farm development and that windfarms of a bigger scale are acceptable.

There are grid connection options for the project at Upperchurch. The electricity can be transported to the National Grid by a combination of cable and overhead line to a connection point on the Killoan to Nenagh 110kV line. The project has secured access to the National Grid in the Gate 3 Grid Connection process operated by ESB Networks.

The proposed turbine sites enjoy a favourable wind regime and are not within a Natura 2000 or a p.NHA designated ecology site.

Potential noise impacts on local residences were assessed by Malachy Walsh & Partners. Modern turbines can be operated in different modes where the sound output is kept within a defined level. The results of this assessment have been based on a typical turbine suitable for the site, operating in a mode that ensures compliance with the Wind Energy Guidelines noise limits. The results show that the predicted wind farm noise levels adhere to the Guidelines at all locations.

The results of the shadow flicker model show that shadow flicker effect is unlikely to be a problem at the nearest residents due to the unlikely probability of all the conditions for the phenomenon occurring simultaneously, tall trees between potential spots and the turbines and the distance of the proposed turbines from local residences.

Impact on telecommunications was carried out by Ai Bridges, communications consultants. Following extensive study of the signal paths of telecommunications, a final layout was designed so that the turbines will not interfere with the signals in the area. In any case remedial measures are readily available to solve any problems that might arise.

Impacts on the Landscape were assessed by Mozart, Landscape Architects. They conclude that the surrounding undulating topography provides screening for the development and high banks and hedgerows allow only intermittent views within a 5km radius. The landscape context is one of a working landscape with many anthropogenic elements, including wind turbines, communications mast, electricity and telephone lines, once off rural housing and farmsteads, farms buildings and roads. This setting provides a relatively high visual absorption capacity. The visual impact of the proposal is identified in Zone of Visual Impact Figures and 22 Photomontages within the study area.

Habitats, flora, and fauna of the proposed site were assessed by Malachy Walsh and Partners (MWP), Environmental and Engineering Consultants. This assessment describes the ecology of the site, with emphasis on habitats, flora, fauna and water quality, and assesses the potential effects of the proposed windfarm development on these ecological receptors. The assessment included identification of the habitats on site, assessment of the effect of the proposal on designated sites, an Appropriate Assessment to determine the significance of the impact on Natura 2000 sites and an assessment of NHAs not covered by Natura 2000 sites. A winter and summer hen harrier study was conducted along with a bat survey and mammal survey. The field surveys were conducted by ecologists during the month of June 2012. A Sediment and Erosion Plan was developed to protect water quality on site down-stream of the development. Following their assessment, MWP concluded that no significant ecological residual impacts are expected as a result of the construction and operational phase of the proposed Upperchurch Windfarm.

MWP also assessed the potential impacts to the soils and geology of the environment from the proposed turbines. Detailed site surveys were carried out in conjunction with a review of existing data, mapping, geology and drainage features on site. They assess that there is a very low risk of slippage or landslides in the site because of the stable sub-surface ground conditions as determined in the site investigations and the absence of any significant peat coverage. They recommend that the site drainage be regularly monitored, and maintained to ensure the constructed drainage performs through to the operational phase of the project and is fit for purpose thereafter.

MWP also assessed the potential impact on Hydrology and Hydrogeology. This study describes the existing hydrological characteristics at the proposed wind farm site. The surface water features and characteristics are described, as well as the site drainage and groundwater. An impact assessment was carried out to determine whether the project poses a significant impact to the hydrology and hydrogeological aspects of the environment and to propose mitigation measures to reduce any potential negative impact of the proposed wind farm. The study included initial site walkovers and surveys followed by detailed site investigations which included peat probing and trial pits. Trial pits were excavated at 20 of the proposed turbine sites and peat depth and classification was measured at the remaining three sites which are in forested areas. Field hydrochemistry measurements were taken in-situ and water samples were collected for laboratory analysis. Following this detailed assessment MWP conclude that the development of the Upperchurch wind farm will not have a significant impact on Hydrology and Hydrogeology provided mitigation measures are implemented. These mitigation measures are set out in the Sediment and Erosion Plan.

In conclusion MWP assess that this wind farm will not have a significant impact on Soils and Geology or Hydrology and Hydrogeology provided mitigation measures are implemented and given the inherent low risk nature of the site.

The archaeological impacts of the proposal were assessed by Kilkenny Archaeology, consultant archaeologist, and they conclude that there will be no direct impacts on any recorded archaeological sites, features or items due to the construction of the turbines. Kilkenny Archaeology state that the possibility exists that previously unknown archaeological material could be impacted upon by the proposed development given the high number of Recorded Monuments in close proximity to development and recommend that all groundworks associated with the proposed development be archaeologically monitored under licence to the National Monuments Service. It is also recommended that a buffer-zone where development is precluded, be instituted around the single Recorded Monument in the proposed development area. They also state that archaeological sites within the study area will have intervisibilty with the turbines and therefore the operational phase the development will lead to a visual impact upon the archaeological landscape.

The jobs and opportunities that will be created both during the construction and the operation phase of the proposed windfarm in Upperchurch are;-

- Annual rental payments to 37 landowners, 35 of whom live locally.
- Annual community benefit payment to local community development groups.
- Commercial Rates will be paid annually to the Local Authority.
- General activity on the site will increase business in the local service industry i.e. accommodation and restaurants for a period of 8 months.
- There will be increased orders at local concrete plants and quarries.
- 277 temporary jobs in civil and electrical construction companies, legal and accountancy firms, financial services sector, insurance sector, quarry and stone suppliers and project management.
- 28 permanent jobs operation and maintenance, legal, electricity sales, asset management
- €20 million will be spent in Ireland on the civil and electrical contracts

The windfarm will produce substantial amounts of green electricity, enough for the domestic requirements of North Tipperary and thereby contribute to the reduction of environmentally harmful emissions associated with the generation of electricity by conventional means. The generation of the amount of electricity from the wind will improve our country's balance of payments (€10m) because it avoids the importing of oil, coal and gas.

The valuable wind resource in this area can be harnessed without significant adverse impacts to the locality and the environment. The proposal to develop the windfarm will bring benefits to local farmers and the local community, benefits to the county with increased commercial rates and to the region with increased employment and activity in the growing wind energy sector.